S. HRG. 100–271

TECHNOLOGY COMPETITIVENESS ACT OF 1987

HEARINGS

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

FIRST SESSION

ON

S. 907

TO FURTHER UNITED STATES TECHNOLOGICAL LEADERSHIP BY PROVIDING FOR SUPPORT BY THE DEPARTMENT OF COMMERCE OF COOPERATIVE CENTERS FOR THE TRANSFER OF RESEARCH IN MANUFACTURING, AND FOR OTHER PURPOSES

APRIL 28 AND MAY 19, 1987

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TECHNOLOGY COMPETITIVENESS ACT OF 1987

TUESDAY, APRIL 28, 1987

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 9:30 a.m. in room SR–253, Russell Senate Office Building, Hon. Ernest F. Hollings (Chairman of the Committee) presiding.

Staff members assigned to these hearings: Pat Windham, professional staff member and Mark Farrell, minority professional staff member.

OPENING STATEMENT BY THE CHAIRMAN

The CHAIRMAN. The Committee will please come to order.

I introduced a bill, along with Senator Riegle, on April 3, 1987, S. 907, the Technology Competitiveness Act of 1987. I introduced the bill because this country is in serious danger of losing its world lead in technology. Sure, we are still number one in the world in basic science and ideas, but at a time when technology is America's one great comparative advantage in a world of low-wage competitors, the Japanese and others all too often turn our ideas into commercial products before we do and then manufacture them better and less expensively.

As we all know, Japanese advances are no longer restricted to a few basic industries. Now they are poised to take over large portions of the semiconductor industry and other high technology sectors.

This Nation's problems with manufacturing and commercialization cannot be solved by Washington alone. Business and labor can and will take the lead, but it is also true that our government has the responsibility to fund the fundamental research that no one company can afford, including research to help manufacturing and product commercialization.

The Government also has a responsibility to transfer that research to those who need it. It is high time we get the Federal Government's research programs on the side of American industry, and that is what my bill is designed to do. This bill focuses on strengthening and expanding existing Commerce Department technology programs. In particular, it would upgrade the National Bureau of Standards, the one laboratory that provides the quality control techniques and basic technology that industry needs. NBS would become a National Institute of Technology with strength in research in these crucial areas of manufacturing and new technologies.

Other parts of the bill would help transfer that manufacturing research to the small manufacturers who need it most and target financial assistance to help spur more rapid commercialization. Whenever possible, the legislation builds upon the programs already under way in the Federal Government, industry and the states.

[The bill follows:]

100TH CONGRESS
1ST SESSION

S. 907

To further United States technological leadership by providing for support by the Department of Commerce of cooperative centers for the transfer of research in manufacturing, and for other purposes.

IN THE SENATE OF THE UNITED STATES

APRIL 3 (legislative day, MARCH 30), 1987

Mr. HOLLINGS (for himself and Mr. RIEGLE) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

---

A BILL

To further United States technological leadership by providing for support by the Department of Commerce of cooperative centers for the transfer of research in manufacturing, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Technology Competitiveness Act of 1987".

TITLE I—NATIONAL INSTITUTE OF TECHNOLOGY

SEC. 101. Section 1 of the Act of March 3, 1901 (15 U.S.C. 271), is amended to read as follows:

"FINDINGS AND PURPOSES

"SECTION 1. (a) The Congress finds and declares that—

"(1) United States economic growth and industrial competitiveness require continual improvements in manufacturing technology, quality control, and techniques for ensuring product reliability and cost-effectiveness;

"(2) improvements in manufacturing and product technology depend on fundamental scientific and engineering research, in cooperation with industry, to develop (A) the precise and accurate measurement methods and measurement standards needed to improve quality and reliability, and (B) new technological processes by which such improved methods may be used in practice to improve manufacturing and to assist industry to transfer important laboratory discoveries into commercial products;

"(3) interstate commerce, scientific progress, public safety, and product compatibility and standardization also depend on the development of precise measurement methods, standards, and related basic technologies;

"(4) because no one manufacturer or group of manufacturers is able to provide these essential technical services, the Federal Government should maintain a national science and technology laboratory which is able to provide methods, measurement standards, and associated technologies and which is able to work with United States companies to use new techniques to improve products and manufacturing processes; and

"(5) the Federal Government's measurement and technology laboratory also can and should serve as a clearinghouse to assist trade associations, State technology programs, labor organizations, and universities to disseminate information on new basic technologies, including automated manufacturing processes, to interested large and small industrial companies which face strong competition from foreign sources.

"(b) It is the purpose of this Act to establish a National Institute of Technology to serve as a national laboratory which will provide the measurement and technological services essential for scientific and engineering progress, interstate commerce, improved product reliability and manufacturing processes, and guaranteeing that products protect public safety.".

SEC. 102. Section 2 of the Act of March 3, 1901 (15 U.S.C. 272), is amended to read as follows:

"ESTABLISHMENT, FUNCTIONS, AND ACTIVITIES

"SEC. 2. (a) There is established within the Department of Commerce a science and technology laboratory to be known as the National Institute of Technology (hereinafter referred to as the 'Institute'.).

"(b) The Secretary of Commerce (hereinafter referred to as the 'Secretary') is authorized to—

"(1) develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for making measurements consistent with those standards, including comparing standards used in scientific investigations, engineering, industry, commerce, and educational institutions with the standards adopted or recognized by the Federal Government;

"(2) contribute to United States industrial capacity by conducting research and cooperating with industry to develop the measurements, measurement methods, and basic technology needed to improve quality control, to modernize manufacturing processes, to ensure product reliability, manufacturability, functionality, and cost-effectiveness, and to facilitate the more rapid commercialization of products based on new scientific discoveries in fields such as automation, advanced materials, biotechnology, and optical technologies;

"(3) determine, compile, and evaluate physical constants and the properties and performance of conventional and advanced materials when they are important to science, engineering, education, commerce, and industry and are not available with sufficient accuracy elsewhere;

"(4) develop a fundamental basis and methods for testing materials, mechanisms, structures, equipment, and systems, including those purchased for the use of the Federal Government;

"(5) assure the compatibility of United States national standards with those of other nations;

"(6) cooperate with other departments and agencies of the Federal Government, industry, and private organizations in establishing standard practices, incorporated in codes, specifications, and voluntary consensus standards;

"(7) advise government and industry on scientific and technical problems;

"(8) invent, develop, and (when appropriate) promote transfer to the private sector of devices to serve special national needs; and

"(9) assist interested trade associations, State technology agencies, labor organizations, and universities to disseminate information on new basic product and process technologies, particularly automated manufacturing technologies, to interested medium-sized and small companies throughout the United States.

"(c) In carrying out the functions specified in subsection (b) of this section, the Secretary may—

"(1) construct physical standards;

"(2) test, calibrate, and certify standards and standard measuring apparatus;

"(3) study and improve instruments, measurement methods, and industrial quality control and quality assurance techniques;

"(4) cooperate with the States in securing uniformity in weights and measures laws and methods of inspection;

"(5) prepare, certify, and sell standard reference materials for use in ensuring the accuracy of chemical analyses and measurements of physical and other properties of materials;

"(6) accept research associates and donated equipment from industry and also engage with industry in research to develop new basic and generic technologies for traditional and new products and for improved production and manufacturing;

"(7) study and develop fundamental scientific understanding and improved measurement methods for chemical substances and compounds, traditional and advanced materials, ionizing and nonionizing radiation, radio waves and signals, and electromagnetic signals;

"(8) develop and test standard interfaces, communication protocols, and data structures for computer, automation, and telecommunications systems;

"(9) perform research to develop standards and test methods to advance the effective use of computers and related systems and to protect the information stored, processed, and transmitted by such systems;

"(10) determine properties of building materials and structural elements, and encourage their standardization and most effective use, including investigation of fire-resisting properties of building materials and conditions under which they may be most efficiently used, and the standardization of types of appliances for fire prevention;

"(11) undertake such research in engineering, mathematics, computer science, materials science, and the physical sciences as may be necessary to carry out and support the functions specified in this section;

"(12) compile, evaluate, publish and otherwise disseminate general scientific and technical data resulting from the performance of the functions specified in this section or from other sources when such data are important to science, engineering, or industry, or to the general public, and are not available elsewhere;

"(13) demonstrate the results of the Institute's activities by exhibits or otherwise as may be deemed most effective, and including the use of scientific or technical personnel of the Institute for part-time or intermittent teaching and training activities at educational institutions of higher learning as part of and incidental to their official duties; and

"(14) undertake such other functions similar to those specified in this subsection as the Secretary determines appropriate.".

SEC. 103. The first section of the Act of July 16, 1914 (15 U.S.C. 280), the first section of the Act of March 4, 1913 (15 U.S.C. 281), and the first section of the Act of May 14, 1930 (15 U.S.C. 282), are repealed.

SEC. 104. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), is amended by adding at the end the following:

"STUDIES BY THE NATIONAL ACADEMIES OF ENGINEERING AND SCIENCES

"SEC. 19. The Director shall, to the extent appropriations are available, periodically contract with the National Academy of Engineering and the National Academy of Sciences for advice and studies to assist the Institute to serve United States industry and science. The advice and studies may include—

"(1) significant national needs and opportunities in manufacturing and emerging technologies; and

"(2) potential activities of the Institute, in cooperation with industry and the States, to assist in the transfer and dissemination of new technologies for manufacturing and quality assurance.".

SEC. 105. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), is amended by striking "National Bureau of Standards", "Bureau" and "bureau" wherever they appear and inserting in lieu thereof "Institute".

TITLE II—COOPERATIVE CENTERS FOR THE TRANSFER OF RESEARCH IN MANUFACTURING

SEC. 201. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), as amended by this Act, is further amended by adding at the end the following:

"SEC. 20. (a) The Secretary, through the Director, shall provide assistance for the creation and support of regional Cooperative Centers for the Transfer of Research in Manufacturing. Such Centers shall be affiliated with any university, or other nonprofit institution, or group thereof, that applies for and is awarded a grant or enters into a cooperative agreement under this section. Individual awards shall be decided on the basis of merit review, peer review, or similar mechanism. The objective of the Centers is to enhance productivity and technological performance in United States manufacturing through—

"(1) the transfer of new basic manufacturing technology and techniques developed at the Institute to Centers and, through them, to manufacturing companies throughout the United States;

"(2) the participation of individuals from industry, universities, State governments, and, when appropriate, the Institute in cooperative research and technology transfer and research activities;

"(3) the training, education and participation of individuals in the use of new manufacturing and production technologies;

"(4) the further development of a generic research base in manufacturing technology, with special attention to economically significant activities in which individual companies have little incentive to perform themselves, to state-of-the-art manufacturing issues, and to efforts to make new manufacturing technology and processes usable by small and medium-sized companies in the United States;

"(5) the dissemination of scientific, engineering, and technical information about manufacturing to other researchers and to industrial firms, including small and medium-sized manufacturing companies;

"(6) the utilization, when appropriate, of the expertise and capability that exists in Federal laboratories other than the Institute; and

"(7) the development of continuing financial support from other mission agencies, from State and local governments, and from industry and universities through, among other means, fees, licenses, and royalties.

"(b) The activities of the Centers shall include—

"(1) the establishment of experimental automated manufacturing systems, based on research by the Institute, for the purpose of demonstrations, technology transfer, and research;

"(2) the transfer and dissemination of research findings and Center expertise to a wide range of companies and enterprises, including, whenever possible, small and medium-sized manufacturers; and

"(3) basic research supportive of technological and industrial innovation in manufacturing processes, including the adaptation of robotics, computer-integrated manufacturing, and systems integration to meet the generic needs of specific types of manufacturing industries.

"(c)(1) The Secretary may provide financial support to any Center created under subsection (a) of this section for a period not to exceed ten years. The Secretary may not provide to a Center more than 50 per centum of the capital and annual operating and maintenance funds required to create and maintain such Center.

"(2) A person may submit to the Secretary an application for financial support under this subsection. In order to receive assistance under this section, an applicant shall provide information considered adequate by the Secretary that private, university, State, or other non-Federal sources have furnished adequate assurances of contributions of funds equal to or greater than 50 per centum of the proposed Center's capital and annual operating and maintenance costs. Each applicant shall also submit, as part of such applicant's proposal, a plan for the allocation of the legal rights associated with any invention which may result from the proposed Center's research and technology transfer activities.

"(3) The Secretary shall subject each such application to merit review, peer review, or other similar process. In making a decision whether to approve such application and provide financial support under this subsection, the Secretary shall consider (A) the merits of the application, particularly those portions of the application regarding technology transfer, training and education, and research to adapt manufacturing technologies to the needs of particular industrial sectors, and (B) geographical diversity.

"(4) The provisions of chapter 18 of title 35, United States Code, shall (to the extent not inconsistent with this section) apply to the promotion of technology from research by Centers under this section.

"(d) There are authorized to be appropriated for the purposes of carrying out this section not to exceed $40,000,000 for fiscal year 1988, not to exceed $40,000,000 for fiscal year 1989, and not to exceed $40,000,000 for fiscal year 1990.".

TITLE III—PRODUCTIVITY AND TECHNOLOGY ADMINISTRATION

SEC. 301. (a) Section 5(a) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704(a)) is amended to read as follows:

"(a) IN GENERAL.—There is established in the Department of Commerce a Productivity and Technology Administration, which shall operate in accordance with the provisions, findings, and purposes of this Act. The Administration shall include—

"(1) the National Institute of Technology, whose Director shall report directly to the Under Secretary;

"(2) a policy analysis and information office, which shall be known as the Office of Productivity, Technology, and Innovation;

"(3) the National Technical Information Service; and

"(4) such other agencies, programs, and activities of the Department of Commerce as the Secretary determines should be included within the Administration.".

(b) Section 5(b) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704(b)) is amended to read as follows:

"(b) UNDER SECRETARY AND ASSISTANT SECRETARY.—The President shall appoint, by and with the advice and consent of the Senate—

"(1) an Under Secretary for Productivity and Technology, who shall be compensated at the rate provided for level III of the Executive Schedule in section 5314 of title 5, United States Code; and

"(2) an Assistant Secretary for Productivity, Technology, and Innovation, who shall be compensated at the rate provided for level IV of the Executive Schedule in section 5315 of title 5, United States Code.".

(c) Section 5(c) of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704(c)) is amended to read as follows:

"(c) DUTIES.—The Secretary, through the Under Secretary and on a continuing basis, shall—

"(1) supervise and manage the Administration and its agencies, programs, and activities; and

"(2) consistent with the provisions, findings, and purposes of this Act and the Act of March 3, 1901 (15 U.S.C. 271 et seq.), cooperate with United States industry to formulate and carry out policies and activities to assist industry to improve its productivity, technology, and ability to compete successfully in world markets.".

(d) Section 5 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3704) is amended—

(1) by redesignating subsections (d) and (e) as subsections (e) and (f), respectively; and

(2) by inserting immediately after subsection (c), as amended by this Act, the following:

"(d) FURTHER DUTIES.—The Secretary, through the Under Secretary and Assistant Secretary and on a continuing basis, shall conduct policy analyses and propose public and private actions to improve United States industrial productivity, technology, and innovation. As part of such responsibilities, the Secretary, through the Assistant Secretary, shall—

"(1) determine the relationship between technological developments and international technology transfers and the productivity, employment, and performance of United States and foreign industries;

"(2) monitor and analyze the efforts of other nations to target industries and markets within the United States;

"(3) identify technological needs, problems, and opportunities within and across industrial sectors which, if addressed, could make a significant contribution to the economy of the United States; and

"(4) propose and publicize public and private actions which may improve industrial productivity and technologies in the United States, including policies which make the results of Federally-funded research and development more useful to United States industry;

"(5) propose and support studies and policy experiments, in cooperation with other Federal departments and agencies, to determine the effectiveness of measures with the potential of advancing United States technological innovation;

"(6) provide that cooperative efforts to stimulate industrial innovation be undertaken between the Assistant Secretary and other officials in the Department of Commerce responsible for such areas as trade and economic assistance;

"(7) encourage and assist the creation of centers and other joint initiatives by State or local governments, regional organizations, private businesses, institutions of higher education, nonprofit organizations, or Federal laboratories to encourage technology transfer, to stimulate innovation, and to promote an appropriate climate for investment in technology-related industries;

"(8) propose and encourage cooperative research involving appropriate Federal entities, State or local governments, regional organizations, colleges or universities, nonprofit organizations, or private industry to promote the common use of resources, to improve training programs and curricula, to stimulate interest in high technology careers, and to encourage the effective dissemination of technology skills within the wider community;

"(9) consider government measures with the potential of advancing United States technological innovation and exploiting innovations of foreign origin; and

"(10) publish the results of studies and policy experiments.".

TITLE IV—ASSISTANCE OF COMMERCIALIZATION AND MANUFACTURING

SEC. 401. The Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3701 et seq.) is amended—

(1) by redesignating sections 6 through 18 as sections 7 through 19, respectively; and

(2) by inserting after section 5 the following:

"PROGRAMS TO ASSIST COMMERCIALIZATION AND MANUFACTURING

"SEC. 6. (a) COMMERCIALIZATION AWARDS TO SMALL BUSINESSES.—(1) The Secretary, through the Under Secretary, shall establish a program for the purpose of making awards to United States businesses with less than 500 employees in order to assist such businesses to commercialize new scientific discoveries of great potential economic and competitive value. The awards program shall have—

"(A) a first phase for determining, to the extent possible, the scientific and technical merit and feasibility of proposals submitted pursuant to program solicitations; and

"(B) a second phase to develop further proposals which have shown particular technical merit and feasibility during such first phase.

Where two or more proposals specified in subparagraph (B) of this paragraph are evaluated as being of approximately equal technical merit and feasibility, special consideration shall be given to those applicants who show evidence of funding commitments from non-Federal sources of capital.

"(2) An award made under the first phase specified in paragraph (1)(A) of this subsection shall not exceed

$100,000. An award made under the second phase specified in paragraph (1)(B) of this subsection shall not exceed $1,000,000.

"(b) COMMERCIALIZATION AWARDS TO JOINT RESEARCH VENTURES.—(1) The Secretary, through the Under Secretary, shall encourage United States companies to form joint research and development ventures for the purpose of rapidly creating the generic technology necessary to commercialize new scientific discoveries of great economic and competitive potential value. In addition, the Secretary may provide financial awards to assist in the establishment and operation of such joint ventures.

"(2) No award made under paragraph (1) of this subsection shall be made for more than one-third of the total cost of the joint venture over its lifetime or its first five years, whichever occurs first. No award shall be made for more than five years.

"(3) In determining whether to make an award to a particular joint research and development venture, the Secretary shall consider whether the corporate members of the joint venture have made provisions for the participation of small United States businesses in such joint venture.

"(4) The Secretary may, as appropriate, authorize the participation of the National Institute of Technology in any joint research and development venture created under paragraph (1) of this subsection.

"(5) As used in this subsection, the term 'joint research and development venture' has the meaning given to such term in section 2(6) of the National Cooperative Research Act of 1984 (15 U.S.C. 4301(6)).

"(c) SMALL BUSINESS TECHNOLOGY LEASEBACK PROGRAM.—(1) There is established in the Treasury of the United States a Small Business Technology Leaseback Fund (hereafter in this section referred to as the 'Fund').

"(2) Effective October 1, 1987, there is authorized to be appropriated $50,000,000 for the purpose of providing capital to the Fund.

"(3) The Secretary, through the Under Secretary, is authorized and directed to—

"(A) use capital from the Fund, with the approval of the Secretary of the Treasury, to purchase advanced automated manufacturing equipment made in the United States, particularly flexible manufacturing systems, suitable for use by small manufacturing firms in the United States;

"(B) solicit proposals from United States manufacturing firms with less than two hundred and fifty employees which wish to lease such manufacturing equipment; and

"(C) lease such equipment to those applicants who demonstrate an ability to use such equipment to improve manufacturing productivity and quality and who demonstrate a willingness to share the expertise they develop through the use of such equipment with other small manufacturing firms and with the Cooperative Centers for the Transfer of Research in Manufacturing created under section 20 of the Act of March 3, 1901.

"(4) The Secretary shall promulgate regulations to carry out the provisions of this subsection, including provisions regarding lease periods and financial and legal aspects of such leases.".

TITLE V—AUTHORIZATION OF APPROPRIATIONS

SEC. 501. The Act of March 3, 1901 (15 U.S.C. 271 et seq.), as amended by this Act, is further amended by adding at the end the following:

"SEC. 21. (a) There are authorized to be appropriated for fiscal year 1988 to the Secretary of Commerce to carry out activities performed by the Institute (other than activities performed under section 20 of this Act) the sums set forth in the following line items:

"(1) Measurement Research and Technology: $48,202,000.

"(2) Engineering Measurements and Manufacturing: $50,615,000.

"(3) Materials Science and Engineering: $26,846,000.

"(4) Computer Science and Technology: $9,727,000.

"(5) Research Support Activities: $21,110,000.

"(6) Research Facilities: $9,500,000.

"(b) Notwithstanding any other provision of this or any other Act—

"(1) of the amount authorized under paragraph (1) of subsection (a) of this section, $9,000,000 is authorized only for the purpose of research in process and quality control and $1,500,000 is authorized only for the purpose of computerized data bases;

"(2) of the amount authorized under paragraph (2) of subsection (a) of this section, $5,000,000 is authorized only for research in automated manufacturing, $2,000,000 is authorized only to adapt Institute automated manufacturing technology to meet the needs of small business and various industrial sectors, $3,700,000 is authorized only for the Center for Building Technology, $5,800,000 is authorized only for the Center for Fire Research, $3,500,000 is authorized only for research to improve lightwave communication systems and related technologies, $3,000,000 is authorized only for the purpose of research to improve bioprocess engineering, $1,000,000 is authorized only for new microwave measurements, and $3,000,000 is authorized only for new research on semiconductor materials, devices, and manufacturing processes;

"(3) of the amount authorized under paragraph (3) of subsection (a) of this section, $3,500,000 is authorized only for the purpose of research to improve high-performance composites;

"(4) of the amount authorized under paragraph (4) of subsection (a) of this section, $1,500,000 is authorized only for the purpose of research in advanced information systems;

"(5) of the amount authorized under paragraph (5) of subsection (a) of this section, $9,213,000 is authorized only for technical competence fund projects in new areas of high technical importance, and $2,610,000 is authorized only for the Postdoctoral Research Associates Program and related new personnel; and

"(6) of the amount authorized under paragraph (6) of subsection (a) of this section, $6,500,000 is authorized only for the cold neutron research facility, and $3,000,000 is authorized only for semiconductor research facilities.

"(c) Appropriations made under the authority provided in this section shall remain available for obligations, for expenditure, or for obligations and expenditure for periods specified in the Acts making such appropriations.".

SEC. 502. Section 18 (a) and (b) of the Stevenson-Wydler Technology Innovation Act of 1980, as so redesignated by section 401 of this Act, is amended to read as follows:

"(a)(1) There is authorized to be appropriated to the Secretary for the purposes of carrying out sections 5, 11(g), and 16 of this Act not to exceed $8,000,000 for the fiscal year ending September 30, 1988.

"(2) Of the amount authorized under paragraph (1) of this subsection, $1,000,000 is authorized only for the Office of the Under Secretary for Productivity and Technology; $4,000,000 is authorized only for the Office of Productivity, Technology, and Innovation; and $3,000,000 is authorized only for the purpose of carrying out the requirements of the Japanese Technical Literature Program established under section 5(e) of this Act.

"(b) In addition to the authorizations of appropriations made under subsection (a) of this section and section 6(c)(2) of this Act, there is authorized to be appropriated to the Secretary for the purposes of carrying out section 6 (a) and (b) of this Act not to exceed $40,000,000 for the fiscal year ending September 30, 1987.".

TITLE VI—MISCELLANEOUS AND CONFORMING AMENDMENTS

SEC. 601. (a) Section 4 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3703) is amended by adding at the end the following:

"(13) 'Administration' means the Productivity and Technology Administration established in section 5(a) of this Act.

"(14) 'Under Secretary' means the Under Secretary for Productivity and Technology appointed under section 5(b) of this Act.".

(b) Section 8(b) of the Stevenson-Wydler Technology Innovation Act of 1980, as so redesignated by section 401 of this Act, is amended by striking "Director" and inserting in lieu thereof "Assistant Secretary".

(c)(1) Section 5314 of title 5, United States Code, is amended by adding at the end the following: "Under Secretary for Productivity and Technology, Department of Commerce.".

(2) Section 5315 of title 5, United States Code, is amended by adding at the end the following: "Assistant Secretary for Productivity, Technology, and Innovation, Department of Commerce.".

○

The CHAIRMAN. This morning the Committee will hear testimony from two panels of experts. We have invited them to testify on the problems facing American industry, on the kinds of strategies and research needed to cope with these problems, and on the provisions of the Technology Competitiveness Act.

I want to thank the witnesses for coming today. We look forward to hearing their views.

On the first panel, we have Mr. Donald Weinert, the Executive Director of the National Society of Professional Engineers; and Donald G. Zook, the Assistant Director of Manufacturing at Caterpillar.

If they would come forward, please. We welcome you to the Committee.

Mr. Zook is also President of the Society of Manufacturing Engineers.

STATEMENT OF DONALD G. WEINERT, P.E., EXECUTIVE DIRECTOR, NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS; ACCOMPANIED BY DONALD G. ZOOK, ASSISTANT DIRECTOR OF MANUFACTURING, CATERPILLAR, INC., AND PRESIDENT, SOCIETY OF MANUFACTURING ENGINEERS

Mr. WEINERT. Thank you, Mr. Chairman. Good morning.

The CHAIRMAN. Good morning.

Mr. WEINERT. I am Donald Weinert, the Executive Director of the National Society of Professional Engineers, and it is indeed a pleasure for me to be here this morning with Don Zook from the Society of Manufacturing Engineers to talk about this important subject.

As you probably know, NSPE, the National Society of Professional Engineers, is a professional society of over 75,000 engineers, all of whom are actively engaged in engineering in education, government, industry and private practice and in construction, and the largest number of our members are engaged in engineering practice in industry, which is very appropriate to these hearings.

We are particularly pleased to be able to join with you in a dialogue on the subject of how the U.S. can be more competitive in the global marketplace. It is clear to us, as it is to you, that there is need for improved effort in manufacturing research, development and application and in increased attention to technological innovation, productivity and quality in the workplace. We think that these issues have reached a critical stage, and now is the time for action. We welcome the opportunity to explore the initiatives reflected in S. 907 with you.

As a matter of fact, this is a subject that has been of great concern to the engineering community for many years, and five years ago the National Society of Professional Engineers commissioned a technology policy task force to address these important concerns.

Incidentally, among the membership of that task force of eight distinguished engineering leaders was Mr. Fred Garry, the vice president for engineering and manufacturing of General Electric Corporation; Mr. Erich Bloch, who was then with IBM Corporation and now the Director of the National Science Foundation; and Dr. Myron Tribus, whose distinguished career, as many of you know, includes service as Assistant Secretary for Commerce in Science and Technology.

The CHAIRMAN. We have heard from Erich Bloch. Mr. Garry was supposed to be with you on the panel this morning.

Mr. WEINERT. He sends his regrets. He had a conflict with his Advisory Committee duties with the National Science Foundation.

That task force, by the way, set forth a plan to reinvigorate America's technology base, and several things have happened since the task force report that we think are very encouraging, and we are beginning to see the benefits.

One of the things that has happened, for instance, is that the National Science Foundation has greatly increased its emphasis on engineering under Dr. Bloch's leadership. We see real progress in giving greater attention to fundamental engineering research in education in the National Science Foundation. That is important to your initiative.

There are other things taking place which we are also very encouraged by: the S. 58 legislation introduced by Senator Danforth, which will restore the R&D tax credit to 25 percent and makes it permanent; and H.R. 812 which Representatives Walgren and Boehlert have introduced to create a national quality improvement award similar to the Deming Prize. We think these incentives are all very important.

The CHAIRMAN. Do you think that tax credit ought to be reinstituted?

Mr. WEINERT. Absolutely.

The CHAIRMAN. There was some evidence from the Finance Committee that these investments would have been made otherwise. The credit itself was more or less a windfall. That is wrong as you see it?

Mr. WEINERT. My evidence is that those incentives are important, particularly in the marginal cases where there may or may not be a decision to move ahead. I am sure there are plenty of instances where you could say, look, these investments are going to be made anyway, but I think there are many marginal areas where people are not going to make those investments without this type of an incentive. So I think it is worthwhile.

Bringing us now to the last and probably most important recommendation out of our NSPE technology task force of several years ago, we come right to your bill, S. 907, because that last recommendation from our task force stated that the national laboratories and other technical activities of the government be given a mandate to support industry when and where appropriate, and that a strategy for these activities be jointly developed by industry and government.

Mr. Chairman, we at NSPE feel that the Technology Competitiveness Act of 1987 is a particularly important piece of legislation because it addresses that last recommendation and conclusion.

There are two very important elements. First of all, it elevates the Department of Commerce role in this area and creates with the productivity and technology administration a focus for leadership within the Department of Commerce.

We feel that the Department of Commerce ought to have the same role relative to the commercial security of the United States that the Department of the Defense has relative to its military security. There ought to be someone in charge of our commercial security, and I think your bill moves in that direction. We applaud that.

There is a second very important element in this bill, and it is in the authorization section, title 5, section 501 particularly. For those that get in and read that carefully, they will see an increase in the resource commitment to the important roles and missions of the now Bureau of Standards, soon to be National Institute of Technology. We think those increases and resource commitments are reflective of the importance that this Committee places on this important subject.

By the way, we agree with the mission of the newly-established institute which is outlined in title 1, section 1(b). That mission, by the way, and I will read, is to "establish a National Institute of Technology to serve as a national laboratory which will provide the measurement and technological services essential for scientific and engineering progress, interstate commerce, improved product reliability, manufacturing processes and guaranteeing that products protect public safety."

That is a very important and very big mission, but I want to pick up on something you said in your introductory remarks. We must be careful that we do not jeopardize the existing mission and important role inherent in the National Bureau of Standards, particularly in the metrology area and the development of standards for manufacturing.

There would be a temptation in some of these expanded programs for them to divert attention that is essential to keep manufacturing technology at its proper level of development.

The CHAIRMAN. Right now, Mr. Weinert, as I see it, there is no emphasis whatever on that commercialization. I am frustrated. The University of Houston developed, or rather, I should say, discovered, a superconductor. What they did not do is develop a product.

Mr. WEINERT. Yes.

The CHAIRMAN. We will get the Nobel Prize for that, but the Japanese will get the profits. Within two weeks they had a consortium organized to develop and commercialize.

Can you elaborate from your experience and expertise how you envision, perhaps, that an Institute of Technology would work in the commercialization of these particular discoveries and engineering advancements? That we are making.

Mr. WEINERT. Well, I believe that how they will work is reflected in part in the cooperative centers for the transfer of research in manufacturing.

What we need is a place where particularly medium- and small-sized industries can come and be exposed to the latest in ideas, the latest in technologies, figure out how they can adapt those ideas and those technologies to their particular industrial process and quickly go back having access to capital and implement those things. They need ideas. They do not need so much force feeding of money, force feeding of equipment. What they need is access to ideas, to the available new technologies.

I think that if you make these ideas available in the centers that the NIT will administer, you will then create a culture in the medium and small-sized industries that will allow them to quickly take new technologies, new discoveries, and make products with them. What holds them back now is their inability to develop the design and integrated manufacturing process that is necessary to produce a commercially competitive product. If they have access to those ideas and can figure out how to apply them to their own particular industry, I think you will accomplish what you are talking about.

It is partly a change in the culture. The Japanese culture is oriented to doing just what you have described.

The CHAIRMAN. You do not think our culture is?

Mr. WEINERT. I think it can be the minute we begin to promote the type of cooperative atmosphere between industry, government, state and local, by the way, as well as federal, and the academic sector. I think we are beginning to do that in many areas in education. I think your bill will begin to do that in some of these areas of application.

The CHAIRMAN. Is there anything that likens this in America today? You are a professional engineer, and you would like to go and study some ideas, as you say, in order to design and develop. Where would you go today if you were looking? If you had the money, you had the investment, you had the backers, you had the staff, the personnel, you had the facilities, where would you go today in America?

Mr. WEINERT. I believe your second panel is going to contain two people who are involved partly in that process.

The CHAIRMAN. I just wanted to hear what you were going to say about it.

Mr. WEINERT. There are individual places to go, but there is no organized national source. Let us take the agricultural extension service system, which has made U.S. agriculture the most powerful and successful agricultural enterprise in the world. It is based on information transfer at the local level. Every farmer has access to an agricultural extension agent.

We can, through this bill and through these centers and perhaps by reviving an act that is already on the books, set up information centers at the local level, the state level, which will facilitate the transfer of this knowledge and this technology. I think that is what we need. We need to have ready access by the small and medium-sized businesses to this type of knowledge, to the type of information that is available through these centers.

At any rate, let me continue and talk a little bit more about the centers themselves. We believe that there should be a partnership between these cooperative centers for the transfer of research in manufacturing and the National Science Foundation efforts in research and education because they support each other. They are mutually supportive. Neither alone can do the job you want to see done, but I think the educational base and the research base feeding into the application base that you have in mind should work together.

The engineering research centers, by the way, that have been instituted by the National Science Foundation have enjoyed some successes, they have also had some problems, and I think that in creating the cooperative centers envisioned in your bill, much can be learned and I think should be learned from the experience of the National Science Foundation.

There is an excellent feature, by the way, in title III of the proposed legislation which is the Commercialization Awards. We think that those awards to small businesses and joint research ventures are just at the right tone. They are seed money. They assist in getting started. They do not then allow the manufacturing firms to become reliant on Federal funding, and we think that is an important aspect of that title III provision. The Federal Government should not become the primary source in these programs. They should be the catalyst.

There is another feature in title III that also is extremely important. It relates to that information exchange process that I was talking about a minute ago, and that is with the National Technical Information Service, the NTIS. That organization is currently critical in the information exchange process in the United States and is involved, as you may know, in a major consortium of the information services of the Department of Defense, Department of Energy, Commerce and NASA. CENDI is the acronym, by the way, because we have to have an acronym for everything.

That consortium is extremely important not only in sharing technical information among the data bases of these major Federal Government departments, but it is also very important in establishing procedures for cataloging and processing information, standardizing that business.

We think, incidentally, that the NTIS should continue to be involved in that consortium. As I mentioned earlier, that is where we might want to talk about the State Technical Services Act, which is on the books but has not really been implemented, not funded, to create at the local and state level information consortia or centers that can access this national series of data bases, patch into the Federal effort.

Again, we would have our analogous piece to the agricultural extension service but this time in manufacturing technology and research results.

Now, there is one area that we would like to urge some reconsideration or at least clarification of intent, and that has to do in the title IV leaseback program that is proposed. We feel strongly that the Federal Government should not be, as we say, the financial engine that drives the automation of manufacturing. We think that is a private sector enterprise. What we think is necessary is to provide access to knowledge and ideas to the medium and small businesses, not to force feed them money and things. Let them decide what things best fit their industrial setting and then help them in getting the money to fund those changes.

So we think that if the Federal Government were to get into a program of buying automated manufacturing processes, technologies and equipment and leasing them to these small and medium industries, first of all you would need infinitely more money than this bill provides because these are very expensive pieces of equipment and technologies.

Secondly, the Government would end up owning these technologies, these pieces of equipment, these processes which become very quickly obsolete. Better that they be the catalyst for ideas and not the provider of the actual automation equipment itself.

The Chairman. From your experience, that is the flaw? If we started actually at the Government level purchasing and leasing robots, technological machinery and otherwise, we are getting into trouble.

Mr. Weinert. I agree with you. You are getting into trouble. First of all, you are biting off a tremendous financial commitment. It is very, very expensive, and I do not think you could ever expect the kind of Federal funding that would be necessary to support an effective leaseback program.

It becomes obsolete very quickly, and if the Government is buying it and providing it, then what is happening really is that these industries are getting what the Government thinks they should best have rather than the industry deciding which variation of that piece of equipment is best suited to their purpose. I think we ought to let the emphasis come from them, not be forced down from the Government.

I would like to conclude my comments on the bill by bringing out an area that I think perhaps needs a great deal more attention both in your bill, if possible, but also with the National Science Foundation and with other Government entities. That has to do with education, the development of the human resources.

We forget, I think, sometimes that having all of this marvelous technology and knowing how to automate a manufacturing process and knowing how to warehouse and how to market is all we really need. What we really need, of course, are people that can integrate that knowledge, that can back away and design strategies for the application of technology. Our educational process does not provide good preparation for our engineers and technicians and technologists in this area.

We need to work more on educating our human resources on how to manage technology, how to develop strategy.

The Chairman. Why can't we do this in America? You know, when you look at higher education and its true cost we are in effect educating the Japanese to put us out of business. Over 50 percent, over half of the graduate students in engineering, are foreign students. You and I pay 40 percent of that cost.

So we have wonderful technical and engineering graduate degree programs here in the United States for Tokyo. It is working well. You and I pay for it, and we have these silly State Department folks running around saying in the morning's news they will not agree that there is a need to do something.

Why is it that we are not attracting more of our own students? They just do not see the opportunity there? From an engineer's standpoint, what has happened to your discipline, Mr. Weinert?

Mr. Weinert. I will be quite candid with you. First of all, I think we would really like to hear from Mr. Zook on this.

The Chairman. All right.

Mr. Weinert. But I do not think there has ever been any real glamour associated with being on the manufacturing floor for engineers. That was a place were technicians went. That was a place where technologists worked sometimes, but there has never been any real premium in the corporate reward system or in our process of development of our engineering work force on being down on the shop floor, if you will, and looking at processes, strategizing about the best way to do things.

It is not good just to come in and throw a bunch of robots and automated equipment in on a manufacturing process. What we probably need to do more often is back away, look at the whole process and say are we doing this thing right at all? Maybe we ought to completely change our approach to this.

Our engineers have not really been prepared for that type of challenge in their undergraduate process. Even today, Capstone Design courses for engineers in engineering education are not as strong as they should be and in some institutions do not exist at all. There is not enough emphasis in our educational process on design, on the concept of identifying what the problems are, of backing away and looking for new ways to do things.

Our educational process tends to emphasize learning what there is to learn, emphasizing that, and not to backing away and saying I want to challenge that. We need to do more challenging. Our engineers need to think that way. When we get engineers on the manufacturing floor that are backing away and saying is that the right way to do things, what is the real problem here, not focusing on whether a robot goes here or whether a sensor goes there or a control process here but back away and look at the whole thing. How does it fit in with materials handling, warehousing, what is the product going to look like.

In other words, you have to look at the entire commercialization process. Engineers need to be educated to think that way. Your Centers, by the way, the centers for the transfer of research in manufacturing, could in fact be living laboratories where engineering students and faculty from the universities could actually be there on these shop floors, if you will, involved in that process. That will help convert their thinking.

At the same time, I would like to suggest that we in this country look at the idea of doing more teaching in the real world in industry. Medicine has applied that approach for years in the teaching hospital. Why not have teaching industries in the United States whereby our engineering students and faculty actually are in the productive workplace, doing as they do, learning as they do.

I think that this is a component of our education and will go a long way to solving the problem that we have just identified.

At any rate, I do, in concluding, want to express appreciation for the initiative that you have taken to get things going, to get a dialogue started. I also understand that over on the House side the Science, Research and Technology Subcommittee is examining legislation this morning which brings also some focus on the National Bureau of Standards and Department of Commerce.

We welcome, by the way, the attention that both houses are paying to this important subject, and we look forward to working with you, sir, in any way we can to make a success of the endeavor that you have in mind.

On behalf of our society, I would like to thank you for this opportunity to appear before you and make these comments, and at this point Mr. Zook and I are prepared to answer your questions if we can.

[The statement follows:]

STATEMENT OF DONALD G. WEINERT, P.E., EXECUTIVE DIRECTOR, NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Mr. Chairman and Members of the Committee: Good morning. I am Donald G. Weinert, P.E., Executive Director of the National Society of Professional Engineers (NSPE). NSPE is a professional society of over 75,000 engineers representing industry, education, government, private practice and construction.

I am pleased to join this Committee in its deliberations on America's ability to compete in the global marketplace. The need for improved U.S. efforts in manufacturing research, development and application, and the need for increased attention to technological innovation, productivity and quality in the workplace has reached a critical stage. Mr. Chairman, I welcome the opportunity to explore the initiatives demonstrated in S. 907, The Technology Competitiveness Act of 1987, as an important step towards America's regaining its competitive posture.

Five years ago, the National Society of Professional Engineers commissioned a Technology Policy Task Force to address this nation's faltering ability to compete internationally, and to recommend an appropriate plan of action. The Task Force was comprised of eight distinguished engineering leaders, including Mr. Fred Garry, Vice President of Manufacturing at General Electric Company; Mr. Erich Bloch, now Director of the National Science Foundation, and formerly with the IBM Corporation; and Dr. Myron Tribus, whose distinguished career includes serving as Director of the Center for Advanced Engineering Study at MIT, Senior Vice President for Research and Engineering at Xerox, and Assistant Secretary of Commerce for Science & Technology. The Task Force set forth a plan to reinvigorate America's technology base. A copy of the Task Force report is being provided with this testimony.

In the period since the Task Force report, several initiatives dealing with other Task Force recommendations have begun, which we believe are making a positive impact. For example, under Erich Bloch's leadership at NSF, engineering has received greater attention and increased levels of funding, and we are just beginning to see the benefits of the industry-university-government partnerships in effect at the NSF Engineering Research Centers. NSPE is proud to have led the successful lobbying effort two years ago, when Congress added engineering to the basic mission statement of the National Science Foundation.

Other Task Force recommendations would be implemented by S. 58, legislation introduced by Sen. Danforth to restore the University R&D Tax Credit to 25% and to make it permanent, and H.R. 812, introduced by Reps. Walgren and Boehlert to establish a National Quality Improvement Award similar to the Deming Prize in Japan. These types of incentive are important components of a reinvigorated American technology base.

One of the most important Task Force recommendations would be, in large measure, implemented by S. 907. That Task Force recommendation stated: National laboratories and other technical activities of the government be given a mandate to support industry where and when appropriate. And that a strategy for these activities be jointly developed by industry and government.

Mr. Chairman, NSPE feels that the Technology Competitiveness Act of 1987 is particularly important for two reasons. First, it is an important step in moving the Department of Commerce into a national leadership role in promoting the technological health of the United States. We applaud the establishment of a Productivity and Technology Administration (PTA) at the Undersecretary level within the Department of Commerce. The Department of Commerce should have the same role relative to the commercial security of the United States that the Department of Defense has relative to the military security of this nation. To provide independent advice and counsel to this effort, I would recommend the resuscitation of the Commerce Technical Advisory Board (CTAB). This advisory board could be composed of representatives of labor, management, academia and state government. It would be empowered to review, critically, the performance of the Department of Commerce in carrying out the intentions of this legislation.

A second important element of S. 907 has to do with the authorization portions of the bill (Title V, Sec. 501). We applaud the increased funding authorized by this section as a reflection of the importance this committee places on the expanded role of the newly designated National Institute of Technology. We agree with the proposed mission of the newly established Institute which is outlined in Title I, Sec. 1(b). That mission is "to establish a National Institute of Technology to serve as a national laboratory which will provide the measurement and technological services essential for scientific and engineering progress, interstate commerce, improved product reliability and manufacturing processes, and guaranteeing that products protect public safety." However, this is a large and important mission and I caution that it not be undertaken at the expense of the important efforts already underway at the National Bureau of Standards. Let me paraphrase a recent National Research Council Evaluative Report on the National Engineering Laboratory of NBS: "The NBS is chartered as the central technical agency of the Federal government to ensure that scientific, industrial and manufacturing effort in the nation have the basic elements of metrology to support the introduction of new science into the mainstream of commerce. [NBS] is chartered to ensure that those elements of commerce in the nation that are so vital to the health and well-being of the citizens are properly understood, and that the basic technology is not only developed but also made readily available to industrial and commercial practitioners." The NBS has made significant headway in numerous programs aimed at improving our manufacturing base, particularly in the area of metrology. For a new Institute to be effective, it must build on the foundation of expertise and information currently in place at the National Bureau of Standards. It also should build on the existing partnerships which NBS has developed with the private sector. With this in mind, we would recommend that Title I Sec. 2(a)(9) of the bill be amended to include professional societies.

We support the proposed manufacturing centers in Title II of S. 907 to bring together the ideas, the people, the organizational structure necessary to assist the American manufacturing community in addressing its needs This is the most appropriate role for the NIT—the role of the facilitator, the broker, the catalyst. The manufacturing centers must be designed to provide the maximum benefits to all participants, and we would hope that in the information of these Centers, a close examination would be made of the Engineering Research Centers established through the National Science Foundation to imitate the successes and avoid the pitfalls which have been discovered in the first few years of these public/private sector partnerships. Where beneficial, NIT Cooperative Centers could be coincident with the ERCs, thereby strengthening the crucial partnership between NSF and NBS/NIT programs, and bringing engineering educators and students more into the process of streamlining the development of our manufacturing technologies.

An excellent feature contained in Title III of the proposed legislation is the establishment of Commercialization Awards to (a) small business and (b) joint research ventures. It recognizes private sector initiatives and provides "seed money" to assist in their development. Manufacturing firms or joint ventures are prohibited from becoming too reliant on Federal funding because of the financial and time limitations placed on Institute involvement by this legislation. These kind of "awards" will demonstrate a commitment by the Institute without suggesting that the Federal government is the primary source of funding for the reinvigoration of America's small and medium-size manufacturers.

A no less important feature of Title III relates to the responsibilities of the NTIS, in the area of information exchange, and technology transfer. NTIS must continue to participate in CENDI, a Federal cooperative effort organized by the Commerce and Energy Departments, NASA and the Department of Defense to coordiante the exchange of scientific and technical information among federal agency databases and develops standards for cataloging and processing information. This technical information exchange consortium already includes many Federal Agencies, and is rapidly being expanded to include professional societies, universities, and industry. The benefits of this type of service cannot be overestimated. One possible vehicle to facilitate information exchange would be the revitalization of the existing State Technical Services Act, whereby states would provide matching funds, and set up similar information consortiums, and patch into the Federal effort. This type of state involvement is critically important.

An area where we would suggest changes is in the Small Business Technology Leaseback Program as described in Title IV of S. 907. The Federal government should not be the financial engine that drives the automation of manufacturing. This is a private sector enterprise.

The Institute's role in the transfer of technology to the small and medium size manufacturing firms, however, should be that of a catalyst, not as the source of advanced automated manufacturing equipment and processes. If the role of the Institute is to be that of a leasing agent, then the funds committed to this venture in the legislation are seriously inadequate. The Institute could better serve by helping to cultivate alternative funding sources for small manufacturing firms, perhaps providing some type of Federal subsidies to these firms to allow them to invest in automated manufacturing equipment and processes. We would further encourage the examination of the feasibility of the establishment of a system for financing improved technology in manufacturing similar to those used in the agricultural credit system as a more appropriate Federal role.

To conclude, Mr. Chairman, let me suggest an area in which this legislation could be strengthened. That area is in the development of our "human resources" and their role in revitalizing our manufacturing capabilities. The United States continues to lead the world in research and discovery of new technology. Regrettably, our weakness is in understanding how to translate this research into manufacturing processes and, consequently, into competitive products. We have not created an environment in the technological community to carry out designs effectively. We need to educate our technical workforce, particularly our engineers, so that they can exercise technological leadership in the broadest meaning of that term to achieve harmony between product, process, and design.

An example of this is the New United Motors Mfg., Inc. (NUMMI) plant in Fremont, California. A joint venture of General Motors and the Toyota Motor Corp., it is run by Japanese management with an American workforce. It has been effectively automated at the lowest level of capitalization, yet it has the highest quality and productivity of all GM plants. We cannot simply invent, we must also innovate, and this innovation should begin with our management of technology practices. Innovation doesn't just occur. I believe the proposed Institute must play an important role in educating not only our existing technical managers, but also in the development of this nation's future technical managers. Further, education in technical leadership should become an integral part of our undergraduate and graduate engineering education programs.

One of the educational concepts which we would suggest for the Institute is similar to the concept of the "Teaching Hospitals," which have proven so vital to the medical profession. The Institute should attempt to involve engineering faculty and students in the practical examination of process control and integrated manufacturing, by encouraging joint industry-university partnerships. These "Teaching Industries" could be located either in the industrial setting or through the proposed new regional "Cooperative Centers for the Transfer of Research in Manufacturing." These joint efforts would not only serve to better educate our managers, students and educators in innovative management, but would facilitate a more complete understanding by all parties of the needs of the manufacturers, thereby focusing the engineering students and faculty on the most appropriate and cost-effective development and applications of new technologies.

I understand that the House Science, Research and Technology Subcommittee is also examining legislation this morning which would bring a renewed focus to the technology programs of the Department of Commerce, particularly the National Bureau of Standards. We welcome the attention that both Houses of Congress have given this initiative, and look forward to working with you and your colleagues in finding answers which will work to restore this nation's ability to compete in the international marketplace.

On behalf of the National Society of Professional Engineers, let me again express my appreciation to you Mr. Chairman for introducing this provocative legislation, and for allowing us the opportunity to appear before you today.

The CHAIRMAN. By the way, Senator Pressler, we are informal here because you and I are running things here this morning. So if you want to interrupt at any time to comment or with an opening statement or with any questions, please do so.

OPENING STATEMENT BY SENATOR PRESSLER

Senator PRESSLER. Thank you, Mr. Chairman. I have a few brief remarks.

I am deeply concerned about the fate of our small businesses. Economic conditions and competition from abroad threaten the extinction of small businesses just as these same factors threaten the American family farm. This doesn't have to occur. The Federal Government supports a number of Federal Laboratories and research efforts that can be used to help small business. Last year's passage of the Technology Transfer Act and the President's recent executive order were steps in the right direction. But these federal labs can improve their ability to share technology. At the NBS authorization hearing earlier this year, this Committee heard that NBS, a Federal Laboratory specifically devoted to serving industry, did not have any current programs designed to help small business. If our firms are to compete, better sharing of Federal Research with small business will be needed.

Our success in the competitiveness battle will also depend on education. Our country will need a skilled and flexible workforce if we are to operate the automated facilities of the future. Machines do not run themselves. They require dedicated and talented persons to ensure their proper operation. Unfortunately, many of our undergraduate institutions fail to offer manufacturing degrees.

As the Commerce Committee works on competitiveness legislation this year, we must remember that there is only so much the Federal Government should do. We cannot continue to spend our nation out of its difficulties. Congressional action can benefit the economy, but it can also do harm. A narrowly targeted increase in government spending or a minor shift in government policy can increase economic activity. On the other hand, an increase in government spending or government intervention may discourage private initiative. Finding the appropriate balance, therefore, is critically important, and requires a thorough knowledge of the alternatives before any decisions are made.

Thank you, Mr. Chairman. I look forward to the testimony of this morning's witnesses.

I will have some questions.

The CHAIRMAN. Do we want to hear from Mr. Zook first? Do you have a statement, or do you just want to respond? Will you comment on some of the things we asked about?

Mr. ZOOK. I have no prepared statement; however, I would like to comment on your last statement, the question with respect to where the manufacturing engineer fits into the scene in the United States versus the rest of the world.

I completely agree with Mr. Weinert that the culture and the educational makeup in the United States has not been one to highly reward the manufacturing engineer. If you look at the European universities, for instance, they have manufacturing engineering programs that are on a par with the other educational programs. They do also in Japan.

In the United States, the manufacturing engineering program is rather rare and is usually considered as an interdisciplinary activity at the graduate level rather than a method of preparing an engineer for a career in industry at the baccalaureate level.

That contrasts completely with the practice in industry in the United States, because typically they will employ the engineer after his graduation at the baccalaureate level; therefore, in effect, they have missed most of those who have training in the manufacturing areas. American industry has, as a result, tended to depend on those who have come up through the ranks and may have minimal education with respect to engineering disciplines. This has disadvantaged us in many cases.

I think that some of the provisions of this bill will help us in bringing attention to the need to encourage more activity in this area, and I certainly support the bill as an indication not only of recognition but as a provision for beginning to do something to address the problem. We would much prefer to see an issue coming before us that would allow the United States to become much more competitive in its manufacturing endeavor as opposed to beginning to build restrictions and walls with respect to our ability to import or export in that connection.

Senator **Pressler**. Let me ask just a question or two, if I might, about education. I know that that is not the principal focus this morning, but I have been very concerned. I am told that about half of our students who are graduate students in engineering are foreign students. Is that correct?

Mr. **Weinert**. That is approximately correct.

Mr. **Zook**. I think the record would show that if you look at the doctoral degrees with respect to foreign students that they do presently in U.S. universities exceed 50 percent. I believe at the master's level we are running somewhere around 35 percent or so, and of course at the baccalaureate level it is much more in balance with U.S. citizens.

Senator **Pressler**. What is the reason for that? Of course, it is not entirely bad. I suppose we want to train our friends. Hopefully we have friends all over the world as a result of it or they become our friends as a result of going to school here; but what is the reason that over 50 percent of the doctorates given in engineering—now, that is engineering but that would not be physics or chemistry or biology, would it?

Mr. **Weinert**. No. That is engineering.

Senator **Pressler**. What is the analogous situation with those disciplines, sciences, mathematics?

Mr. **Weinert**. I do not know.

Mr. **Zook**. I do not know, either, but in engineering certainly it is related to the fact that it has been typical over the years to treat in industry the baccalaureate degree as being the professional degree to begin a career in industry.

In fact, it is typically such that the advanced degrees are attained by the practitioners in industry after they have begun their professional career rather than to have gone through a master's or a doctorate prior to beginning a career in industry.

This is because the salary structure in industry makes very little provision for the advanced degrees as a beginning job. The experience gained in industry is important, and thus they reward the baccalaureate degree very well in comparison to the higher degrees.

Mr. **Weinert**. When you begin practice as a scientist, you begin as a Ph.D. in almost every case.

Senator **Pressler**. What is the basic underlying reasoning? Is it economics, or is our young engineers, our people in that field, or is it that industry just does not pay them? Are there no jobs in the United States for doctorates in engineering?

Mr. **Weinert**. Well, there are jobs for people with doctoral degrees, but for a long time one of the major users of the doctoral degree were the teachers of engineering, the professors. Look at the reward system for a professor of engineering compared to an entry level engineer in a major industry.

Senator **Pressler**. What is the comparison?

Mr. **Weinert**. The industry compensation, just as it is when compared with government, is much, much higher, for example. Now, that has been closing over the past few years with more emphasis in our universities and our engineering schools on providing higher rewards for entry level professors and teachers, but those people are coming with doctorate degrees.

Senator **Pressler**. They make $40,000 or $50,000 a year usually?

Mr. **Weinert**. Not to start with.

Senator **Pressler**. Teaching?

Mr. **Weinert**. They do not start at that level.

Mr. **Zook**. I think we could quantify it perhaps as saying a typical starting salary for a baccalaureate engineer going into industry today is about $27,000. A typical starting salary for a Ph.D. engineer going into education today would probably be in the area of $34,000.

The **Chairman**. A freshman lawyer gets $45,000.

Senator **Pressler**. What is the long-term significance of this in terms of competitiveness, though? Of course, we cannot artificially send people to become doctors in engineering if there are no jobs for them, but it would seem to me that in terms of competitiveness these are the type of people who would be able to do research and produce new products and so forth.

Mr. **Weinert**. You are raising an important point, but I think we better keep in mind that success in manufacturing, success on the manufacturing floor and in the issues that we have been discussing here this morning, it is not necessary from the standpoint of the engineer for there to be a Ph.D. If you are going to do research, yes, that knowledge base is extremely important. If you are going to teach, that knowledge base is extremely important.

There is no evidence that a well-prepared baccalaureate or master's degree engineer cannot adequately deal with the kind of manufacturing challenges that we are talking about. So I do not think we need to presuppose——

Senator **Pressler**. So maybe there is not a problem here.

Mr. **Weinert**. I think the problem is in what type of educational preparation that baccalaureate degree has and what kind of exposure to design and to innovation and to challenge it is providing.

Senator **Pressler**. So you are talking about undergraduate curricula?

Mr. **Weinert**. I am talking about undergraduate. It starts with the undergraduate.

Senator **Pressler**. Well, then let me dig into that a little bit, because as I understand it now, at our military academies you get an engineering degree. Now, is that the same kind of an engineering degree that you would get if you went to the University of Texas, and do you study the same things? What curricula changes would you recommend?

Mr. **Weinert**. Are you talking about the military academies?

Senator **Pressler**. All right, let us talk about them in one category. They are engineers, are they not, when they come out?

Mr. **Weinert**. Well, it depends. They now can specialize in a major.

Senator **Pressler**. In the traditional West Point education, you are an engineer. If you are a military officer, you are lots of things.

Mr. WEINERT. That was true until the middle 1960s. I happen to be a product of that system. So to the middle 1960s, we probably took more science, math, engineering-related curriculum content than almost any engineering school in the country, yes.

There has been a change. There is now a wide range of electives. Only those who choose a particular path could even get enough credits now at West Point or the Air Force Academy or the Naval Academy to qualify for an engineering degree because they have now broadened into an elective process in all of the academies.

Prior to the 1960s, you are absolutely correct. The content was very heavily math, science, engineering, or technically related.

Mr. ZOOK. If the question refers to the consistency of the education of the engineer, it is very consistent in the United States. The holder of a baccalaureate degree in mechanical engineering, for instance, from any institution will have taken a prescribed series of courses that is controlled and monitored by the Accreditation Board for Engineering and Technology. So we do have very excellent consistency across American education with respect to all engineering disciplines.

Mr. WEINERT. There are many of us, however, that do feel that that undergraduate experience needs more in it and some different things in it than it currently has, and there is a fairly large body of opinion that thinks perhaps that educational program ought to be longer than four years, which is the current typical baccalaureate program, although most engineers may take four and a half years to graduate.

Even so, there is a body of thought that feels that ought to be expanded and extended, and some of the nontechnical education that relates to the subject that we are talking about, leadership and management, leadership of technology, management of technology, incorporate more emphasis on design and perhaps a required practical experience component similar to the co-op programs that now exist but make sure every engineer goes through that process.

The CHAIRMAN. Mr. Zook, in your capacity as the President of the Society of Manufacturing Engineers, I am interested in the automated manufacturing research facility at the Bureau of Standards.

Can you comment on it? How important is its work and what position has it put us in with respect to our competition overseas?

Mr. ZOOK. We see it as a very important beginning point from which to embark in this area of manufacturing technology. It is the next step from bringing science into the actual manufacturing of product, but at the end of the point at which the National Bureau of Standards completes their work, there still is a considerable chasm that exists before we can bring that product into fruition on the manufacturing floor.

Some of the provisions of this bill would help us in bringing that to the point at which it can be used both geographically and with respect to the technology involved. By being able to bring the emerging technologies forward through the present system that we have in NBS and then bringing them out of the shelter and bringing them geographically closer and technologically closer to the user, particularly in this human resources area, to use these as an area in which we can advance the knowledge of the small businesses, the medium-sized businesses, say, in the areas of computer integrated manufacturing, this is where the advantage will come, as I would see it, from some of the provisions of the bill.

The CHAIRMAN. I am familiar with the Rapid Acquisition of Manufactured Parts (RAMP) Program of the Navy and their facility which is starting, of course, in my backyard.

Is there a counterpart in civilian industry? Are they trying at any level that you know of through the Bureau of Standards? I understand all this technology and development really was initiated at the Bureau of Standards. I am wondering if there is anything in the private sector as we are doing it now for the Navy? Do you know of any?

Mr. ZOOK. I know of nothing that compares to that in the private sector. We are continuing in the private sector to do as we have traditionally done over the years, and that is that each of the large industries are tending to do their own thing. We are tending to invent a similar wheel many, many times in corporate America, and there is very little in the private sector that acts to bring this together in a coordinated effort.

Of course, the legal restraints that have been on us particularly in past years have actively discouraged any types of cooperative effort, and that is why there is quite a contrast, of course, between the approach in American industry and that of Japanese industry.

Mr. WEINERT. Senator, I would like to point out that that point that was just raised, the culture in this country undergirded by the Sherman antitrust law, which really inhibits the type of cooperation among industries——

Mr. ZOOK. We have been taught not to cooperate.

Mr. WEINERT. That is right. Our culture teaches us not to cooperate. It is against the law.

The CHAIRMAN. Do you think we ought to do away with that? I know we are not the Judiciary Committee, but I am interested in that.

Mr. WEINERT. Sir, I do not want to propose that.

The CHAIRMAN. You do not want to propose that.

Mr. WEINERT. But I think that there needs to be a serious——

The CHAIRMAN. Greater cooperation.

Mr. WEINERT. We need to look at that legislation and see if maybe the way it is applied to industry and these cooperative efforts in manufacturing cannot be modified.

The CHAIRMAN. Will you do that for me? Look at that bill and see if you can. If I knock out the section that is going to make leasebacks of equipment, we will make a deal. I will knock that out of the bill if you will reinsert in lieu thereof how we can get the cooperative kind of language which would promote legislatively cooperative culture among industry and still not be in violation of Sherman or Robinson-Patman or any of the other pricefixing statutes.

Mr. WEINERT. We will look at that.

The CHAIRMAN. Look at that for me, because, you know, necessity is the mother of invention. Roger Millikan is determined not to go overseas, so I have sent people down there. Now I have opened their eyes because I have to come up here and listen to these

Washington silly billies about telling me my textile industry has got to be more competitive. I know we outcompete any textile industry anywhere in the world. I have gone through the Korean textile industry.

He Roger Millikan has done it because he has to survive, and he is using all of these things you are talking about. I have never seen such a research center. You would think they were inventing some kind of money, but it is research upon research to try to stay ahead of the curve. As a result he has high productivity, and he is producing automobile carpet not only for Detroit but for downtown Tokyo, and we deliver.

So I know about our competitiveness. I go into Stoneswear. In a similar fashion, he is in garments, childrens wear. They stamp on the pockets. He has a machine that puts on the buttons, another one that stamps on the collar, and I know Daewo in downtown Pusan would like to get their hands on all of that. He has designed it himself.

We are doing it, and there is a lot out there, but I think this Institute of Technology can facilitate a good bit of it, as you say, and extend those ideas some. We are not doing it in this country. Some are doing it but in a very small way.

Excuse me. Let me yield to my cosponsor of the bill here, Senator Riegle.

Senator Riegle. Thank you, Mr. Chairman.

In the Finance Committee this morning we are starting a markup in a serious way on the Trade Bill. Of course, these issues relate very importantly to the massive trade deficit that we have and which shows no sign of changing, at least not in any way that we can hang our hat on yet.

I want to say to you, Mr. Chairman, how much I appreciate your leadership on this issue and the fact that in drafting this legislation, which I am co-sponsoring with you, I think we are trying to make some breakthroughs, trying to make some things possible within our own economic system so that the private sector can make a surge, which it needs to do.

We are losing an awful lot of high value-added jobs. High living standard jobs are going overseas, and if we do not find a way to move our research and our technology and our innovation out into practical manufacturing applications and products and then on out to the consumer in this country, we are going to continue to fall behind. There is no way that we can meet our needs as a Nation for families or cities or the country as a whole if we are not moving at top speed to make ourselves as efficient, as modern, and as productive as we can be as a society.

We are going to have testimony a little bit later from a company from a Grand Rapids. I will not comment about them now. But they represent what can be done by a smaller-sized company with the application of technology to take and do exactly what your textile people are doing, and that is to increase efficiency. There is no reason why we have to be second to anybody in this world, certainly not Japan or Korea or Taiwan or anybody else.

The thing that disturbs me is that so often we invent the technology, we find the process, and then somebody lifts it from us, takes it overseas, and the next thing we know the products are coming back in and knocking out our people with the inventions that were inventions of our own creation. So we have to find a way to stop this.

I will just say one other thing at this point, Mr. Chairman, and that is this. The Presidential Commission on Industrial Competitiveness that President Reagan named a few years back pointed out at that time that the Japanese were producing twice the number of engineers per capita in their society as we are. That is a terrible problem, the fact that we are not applying ourselves sufficiently to equip enough people in our society with the skills that we need.

That is at one end of the educational scale, but I was just looking at some data the other day. The high school dropout rate, Mr. Chairman, in Japan today is 2 percent. They are getting 98 percent of their young people through high school. The high school dropout rate across the United States today is 24 percent. It is more than 10 times worse than it is across Japan. In my city of Detroit, when we talk about Detroit going head to head with Tokyo, the high school dropout rate today is 59 percent.

We just are not putting our resources in the right places. Now, it is not just money; that is part of it but that is not the whole answer. Families have to work harder together. We have to turn off the TV sets. We have to get kids to open books and spend time reading and doing other things.

We are lagging. We are lagging way behind, and it is no surprise that our economic performance is as dismal as it is in international economic terms when we are not demonstrating our capacity to perform better than that.

So I am all for moving us at the top rate of speed into technology transfer so that we can begin to take advantage of our tremendous inventive capacity in this country, and to some way to share it, get it out into small business, find a way to facilitate the movement of process technology and product technology out there to the smaller companies in this country that employ most of the work force.

I think we can do it, and I think the outline that the Chairman has laid out is on the mark. I thank the witnesses for their testimony so far this morning.

Senator PRESSLER. How much of an attitude change is required before a firm considers automating its facilities?

Mr. WEINERT. I think probably Mr. Zook can offer the best comment on that.

Mr. ZOOK. Could you repeat that question, please?

Senator PRESSLER. Yes. How much of an attitude change is required before a firm considers automating its facilities? I suppose it depends on the economics and so forth, but what goes into that when an engineer tries to persuade a company to modernize or to be more competitive?

Mr. ZOOK. It is less of an attitude change than it is a matter of acquisition of knowledge. If you were to have asked this question five years ago, then yes, there would be a considerable attitude change required, but the pressures of international competition on businesses large and small in the last few years have brought everyone who is still in business to the realization that the change must be made.

The problem in moving forward to some of the automation that is required of an industry, computer integrated manufacturing, the use of flexible manufacturing systems, things of this nature, are largely a matter of the knowledge base that is required to do it.

We have very few of our small industries, particularly, that have even begun the process, say, in terms of what we call truly computer integrated manufacturing. The larger firms that have the resources to do it have given considerable emphasis to this type of activity in recent years, but they are not there yet.

This is a real metamorphosis in industry to make this kind of change. We have come forward over a number of years from a very labor-intensive type of activity through one in which we make use of numerically controlled machine tools; but the big change that has to take place in industry today and the thing that is happening concerns not only the integration of manufacturing functions but also the integration of the information flow throughout the industrial world.

It is this, then, that will allow us to be more competitive by doing such things as reducing the amount of working capital that we have tied up in our inventory, of reducing the length of time that it takes to bring a product from the conceptual stage to the realization stage and from the beginning of the manufacturing process to the end of the manufacturing process. It is the use of this type of technology that is going to allow us to have more flexibility to be able to produce variations of product or different part numbers on the same type of equipment and to do it without elaborate changes in the way that the equipment it set up.

This is a dynamic change, and it is an enormous change in terms of the knowledge base that is required on the part of manufacturing. The small and the medium-sized industries that are having the difficulties staying competitive with what they have and cannot devote the resources to do what is to them perhaps a secondary or tertiary activity as compared to building the product that they have to build today, they are the ones that are suffering.

The larger industries have programs to do this. They are not there yet. They are moving forward. They will get there. They are tending to leave the smaller ones behind, and they are leaving them behind at a time, paradoxically, in which they are depending more on the smaller industries because there is a great tendency in industry today to buy externally rather than to make all their product; and yet those from whom they will buy tend to be those that are less further along in the movement or the integration of computer activities.

Senator **Pressler**. Yes. Yes, I see your point.

One thing that I am interested in also is, can the Federal Government take actions that lead to a change in attitude, or does it require leadership in the private sector? Of course, it requires both regarding decisions such as a firm automating and so forth.

Are there specific things that the Federal Government can do to encourage more automation? Obviously it has to come from private industry, but are there some things we should be doing better?

Mr. **Weinert**. I would like to offer a comment on that.

First of all, I think there is a caution here. The presumption that we should automatically automate everything is a presumption that perhaps we ought to challenge. The very successful joint Japanese/General Motors venture has one of the lowest levels of capitalization in terms of automation of any plant that GM runs. That is the one in California. Yet, it is one of the highest, in fact the highest, in terms of productivity and quality.

It is knowing what type of automation and where to put it and how much that is more important than just blindly saying we ought to automate everything.

I agree 100 percent that the attitude is there. The economic realities have driven the attitude. What the government can do is exactly what this bill proposes to do, and that is to make the knowledge available that allows these people to convert those attitudes into reality. They want to do it. They want to do whatever is appropriate, but they have a hard time getting to it because they do not have access to the information.

So I do not think it is an attitude shift that the Government should force or try to force. I think that is already taking place based on economic reality. I think what is needed is exactly what this bill is aimed at, and that is providing the ideas, the information that these people can have access to and go back and apply in their own industries.

Senator PRESSLER. Is it enough to acquaint people with the new technology, or do they have to be trained to operate it? How much experience or know-how does NBS have in training people to use advanced equipment, and do they have any current programs?

Mr. WEINERT. I think this bill envisions in these Centers, these Cooperative Centers For the Transfer of Research In Manufacturing, that there be a hands-on capability for people to experiment, use, play with these technologies. That is my understanding of it, and that is one of the reasons I urged earlier that we might involve undergraduate engineers and faculty in those same centers so that they can be a part of that hands-on process.

I think some of the people that are in the small and medium-size industries by the way, are key to this process may not even have engineering degrees. They are very savvy people, and if they have an opportunity to come to a place where these things are available, if they can play with it, tinker with it, it does not take them long to say if I adapt this slightly this way, it will do this thing. I can go back and put that into use in our plant.

I think you need the ability for them to be able, if you will, to tinker. As I understand these centers, that ability would be there, if you will.

Senator PRESSLER. How important is it that NBS support regional manufacturing centers if other Federal agencies such as the National Science Foundation can support centers where industry and university can work together?

Mr. ZOOK. We have two different objectives there, it would seem to me. The engineering research centers that are being supported in the last three years by the National Science Foundation are devoted more to the basic research activities of manufacturing. They are into such things as solid forms and such things as basic metallurgical activities that are involved in manufacturing and less so in the implementation activities; whereas what we are talking about here with the National Bureau of Standards would lead more directly toward the implementation activities.

In this area, I think, to respond to a little bit to your previous question, the Government does have a role. I think it has a role both in terms of supporting and in terms of providing leadership in this area. We have a number of groups that are active in different realms with respect to this need, and these are groups such as the universities.

The various engineering programs in the universities, the activities of societies like our own, the professional societies, can play a role here in assisting to develop and to bring to the audience that this bill addresses the type of information that we have.

The other side of it, of course, is industry itself that can come to the party and provide practical information of their own that will mesh together well with the information that is available in the university systems, from NBS and from the technical societies. I think there are four sides to this issue.

Senator PRESSLER. Very briefly, my final question. Would each of you state what you think the one or two strongest and the one or two weakest points, if you were to switch sides in a debate, of establishing a role for NBS in quickly developing and applying new technology to manufacturing processes.

Mr. WEINERT. Of course, one of the strong points, obvious strong points, is the long mission NBS has had related to industrial manufacturing processes, particularly in the standards in the metrology area, and their close relationship with industries.

There have been many, many people from industry actively working in the Bureau over the years, and their active involvement in these types of activities relating to their metrocation and standards process, I think, is something on which to build. So that is something I think is a very strong reason why you should look at the NBS as a possible vehicle for this.

I think one of the weaknesses, is not so much a weakness in NBS as a potential dichotomy, if you will, in the process. The National Science Foundation has focused on education and basic and fundamental research. You are going to have at the Institute a group focused on more practical applications. There is an obvious connection between them. I think one of the possible weaknesses is that the cooperative link will not be forged as strongly as it should, and I think we ought to be very careful that we capitalize on the university-based fundamental engineering research that is being carried out on the one side and the focus on education and marry it with the practical applications of knowledge and technology on the other side and that the two work together. I think I would caution that.

Mr. ZOOK. I would agree that if you were to look through the various areas of the government to select one that is well positioned to begin at this point, that it would be NBS. So I have to believe that we are starting at the right point, that we have a group that already has a little bit of a head start and background in this area.

I do not believe that it would be beneficial to try to pick a weakness in that regard, because as we look at the alternatives, each of those appear to be less firm as a good selection than this one is.

The CHAIRMAN. Senator McCain?

Senator McCAIN. I have no questions, Mr. Chairman.

The CHAIRMAN. One question, Mr. Zook, as head of the engineering society with respect to cooperative research. You know, we passed that act permitting cooperative ventures in 1984. Bobby Inman and MCC got together in electronics down in Austin, Texas. But we have yet to see in the fields of mechanical engineering, machine tools, or other general manufacturing industries any kind of cooperative research.

From your vantage point, why not? Why have they not joined in joint research ventures? Is it a proprietary pressure that says, if we are going to do anything we are going to do it on our own and there is no need for cooperation amongst the large industries? From an engineer's standpoint and your experience, what is your comment?

Mr. ZOOK. I would have to say that it is very difficult to change a lifelong pattern of activity as a result of a bill such as this. Again, to refer to the comments earlier, we have not been brought up that way. In the machine tool industry in the United States there has been a long history of concern about getting too close together because of the legal implications associated with that.

I believe that today so many members of the U.S. machine tool industry have disappeared from the scene. Either they have completely gone under or they have merged together, or they have even become owned by a foreign concern that has made it today still difficult to get together.

The only way in which there is considerable effort in this respect is as a result of the consolidation in the machine tool industry. Now a number of the independents that were still around 10 years ago belong to the same corporate management, and of course they being one are cooperating with each other, so we are not quite as fragmented as we were a few years ago.

The CHAIRMAN. Well, in thanking you, if there are not any further questions, let me say that you are right on target. I am most grateful for your testimony. The Committee is also.

Just one comment with respect to the nature of cooperation and how you have to do it. Some years back, around 27 years ago when I was carpetbagging Michigan, we were dumb. We had corn and cotton and down where the corn and cotton and potatoes grew we did not have any skills. Everybody else had all the skills.

And I can comment openly now because they have a dynamic governor, Jim Blanchard, as well as a Senator here, and they have gotten money to really develop industry. Their attitude then was, if the industry came at that particular time or left or did not come at all, they did not care.

But I still had to prove that we had the skills. So we did just that. We put in a technical training system. I got Clemson University to oversee these moves. I would go to an industry and tell them about our skills.

I will never forget one of them, for example. I was trying to get Freiden Calculator from the West Coast to move east.

They had a board meeting going on, and they said, well Governor, we are sorry but we have already made our decision. We are going into the Netherlands. But Mr. Atkinson, take the Governor out and show him the plant.

Well, I thought that was the last thing that I wanted to see. Atkinson was showing me around and he said, look at these punch drills. He said, under the work rules here, you know, you have got to have one operator for every three machines. We know that one operator can really handle six of these machines and that is 85 percent of the cost of production and we can cut that cost in half.

So after listening to all of that I stopped in at Emerson Meade on the way back to Oakland and, the person I spoke with thought when I said Governor he thought it was governor of the Lions Club. I will never forget.

And we got in anyway and I said, Mr. Meade, I understand you have got this so-called punch drill problem of manufacture, and that it is 85 percent of the cost of your production and we can cut it in half. We know a machine operator that can do this by operating and handling seven machines.

He said, where did you learn all of this. I said, I am a politician. I said, this is what the engineers tell me we can do. So to cut it short, he came. We put in that whole process. If you give us three of those punch drills, we will pay for the supervision, we will pay for the training, and everything else of that kind.

And we would move the industry. We worked cooperatively with our universities down there and developed these centers. Incidentally, we also carpetbagged the Federal Government. Out in St. Louis, they had more fine machinery from Korea and World War II, just sitting there.

So I used to station one person in the Pentagon and two out in St. Louis, and we got half of our machinery to equip the plant from the Federal Government, just on transfers. But now we have to do even more of this because rather than North and South Carolina competing against each other to get industry, we are competing together against Mexico, Taiwan, Singapore, Indonesia.

The whole picture has changed, and I think this is a wonderful presentation you gentlemen here have made, because if we can liken this, as you say, to the Agricultural Extension Service, if we can get a type of commercial, industrial extension service, where America's industry can begin to commercialize and keep up with the culture, keep up with the new ideas coming in and how to modernize and how to stay on top of competition, I think we will have it. We will form our own little MITI.

We thank you very much this morning. We will now have the second panel. Mr. Jacques Koppel, with the Technology Management Group in Philadelphia, and Mr. Robert McIntyre, of Amprotech in Grand Rapids, Michigan.

Senator RIEGLE. Mr. Chairman, I want to just take a minute, as Mr. McIntyre is taking his seat, to introduce him to the Committee and to welcome him before us today. He is here representing Frost, Inc. of Grand Rapids, Michigan.

In many ways this company represents the tremendous changes that have occurred in Michigan industry over the last decade and are occurring, although not to the rate we need to see across the country. Frost, Inc. and their subsidiary, Amprotech, are truly at the cutting edge of technology.

They have shown that manufacturing in America can be every bit as efficient and high quality as any in the world. And they are making a profit at it. And we take our hat off to them.

It is particularly noteworthy that Mr. McIntyre's company is not on the Fortune 500, although one of these days it may be there. Rather it is a family run business that was facing the challenges of the modern marketplace.

It responded by taking a risk and investing heavily in automation of its entire facilities, from office to manufacturing, basically crafting it in-house, as an in-house strategy, and it has worked.

And I am particularly proud of the accomplishments of this company, since it does symbolize a very good example of the commitment Michigan is making to the future, and I very much look forward to his testimony today as it relates to the legislation that you and I are co-sponsoring together, Senator Hollings.

I would hope, Mr. McIntyre, that you would give us today any other ideas or findings that you have had, having come through this experience. In other words, I think this is the time to help others learn from the path that you have been over. Thank you.

The CHAIRMAN. I thank you. We welcome you here to the Committee and I think, Mr. Koppel, that you have a prepared statement. We will hear from you at this time.

STATEMENT OF JACQUES KOPPEL, DIRECTOR, THE TECHNOLOGY MANAGEMENT GROUP

Mr. KOPPEL. Mr. Chairman, I want to thank you for inviting me to testify before this Committee. My name is Jacques Koppel. I am the director of the Technology Management Group, which is headquartered in Philadelphia.

The CHAIRMAN. Incidentally, we will include your statement in its entirety and you can highlight it as you wish, or deliver it in full. Either way.

Mr. KOPPEL. Thank you, sir. Again, thank you for inviting me to testify concerning the use of technology by small U.S. manufacturers. Incidentally, this is one sector of the industrial base that one seldomly hears from. As I said, I have some brief remarks, would be happy to answer any questions you have on this issue.

The Technology Management Group is a small private non-profit corporation, which was established specifically to help the small manufacturing company learn about and adopt advanced manufacturing technologies. We are supported by the Economic Development Administration of the U.S. Department of Commerce, as well as the Commonwealth of Pennsylvania's Ben Franklin Partnership, local government, and some foundation support.

First, just by way of clarification, I want to let you know that my comments are being directed to the use of production technologies. That is, those technologies used by existing companies to improve the way their products are manufactured. I am not going to be addressing the development of new products, new technologies or research and development activities.

Today there are a large number of commercially available manufacturing technologies that companies can use to improve their competitiveness. These include computer numerically controlled machine tools, computer aided design, numerous applications of hardware and software, as well as a host of modern manufacturing techniques.

However, our experience and research indicates that despite a lot of the extensive marketing efforts hoopla and hype, small manufacturers in this country are seriously lagging in their use of these technologies. And this has seriously affected their ability to compete effectively in today's marketplace.

A study we recently conducted indicated that less than 10 percent of small manufacturers were using what could be referred to as modern technologies. I have included the executive summary of this report as part of my statement.

In addition I would like to note that in this 10 percent we are not talking about extensive use of automation or technology. We are referring to one individual piece of technology.

That is, less than 10 percent of the companies were using one piece of new technology. And that could be a computer aided design system or simply the use of the computer for something other than dealing with their accounting systems.

What was particularly disturbing about this were the reasons behind this lag. While the most common excuse that the companies and manufacturers offer is the expense of these technologies, further probing has suggested other factors. In essence, what we have found during our work is that for the most part management really does not understand and is afraid of using computer aided manufacturing technologies.

Many of the reasons for this are due to the environment in which the small manufacturer functions, and the day-to-day dynamics of his operation. The manager of a small company wears many hats. He is always pressed for time and his chief responsibility is making this week's shipments, although he is usually working on last week's.

As a result he really has very little time for investigating new methods to improve his operation. The traditional forms of outside expertise have been consultants and vendors. And these have not been very much help to the small manufacturer. Managers of small companies are generally distrustful or really cannot afford private consultants.

Equipment vendors, on the other hand, while they are very knowledgeable about the technologies they sell, have generally little understanding of the small manufacturer's problems. In addition, these folks are often unwilling to discuss the drawbacks of their own products.

As a result the small manufacturer is essentially isolated and literally has no one to turn to for basic information and new processes. This situation is only made worse by the large number of technologies coming out on the market today, and the increasing number of competing equipment manufacturers.

Currently there are dozens of vendors marketing their equipment and the relative value of these products is difficult to distinguish. This in fact has only added to the confusion.

If one appreciates this situation it is easier to understand why engineers and managers, which really have been schooled before the development of these technologies, are reluctant to exchange their tried and true methods for what they consider to be unproven processes.

Mr. Chairman, what small manufacturers in this country really need is simply someone to hold their hand and help them to dispel doubts about today's technologies. It is really nothing more than that. In addition these companies need help in identifying those technologies that will meet their business agendas.

Senate bill 907 and the establishment of regional Cooperative Centers for Transfer of Research in Manufacturing goes a long way toward meeting this need. However, in addition to developing new technologies, these centers should also have several other capabilities, [we believe.]

Primary among these should be the ability to provide on-site, and this is very important, on-site advisory services to the small manufacturer. This service would be designed to determine which appropriate existing technologies could help them compete more effectively. Programs developed by our organization have shown the value of this type of assistance.

In addition the centers should provide a test bed where new systems could be integrated and debugged without interrupting ongoing production on the shop floor. These services would allay the fears presently held by the small manufacturer and save them perhaps their most precious resource, which is time.

A very simple example is that, when you buy a new piece of equipment, whether it is a robot or a machine tool, it is not simply a matter of bringing it into the shop floor, plugging it in and it is ready to work. There are generally several weeks if not several months of time required to debug and program the piece of equipment.

Generally what happens is that the manager of a plant would have to assign his two best men to try to debug that operation. Now, in effect, the decision that the manager makes is not to spend the six months, since he is already behind in his other projects. So he opts not to buy or acquire the new technology.

The ability of these centers to provide this debugging capability would be extremely helpful to the small manufacturer.

I would like to conclude with two final points. First, it is important to remember that in spite of the continued thrust to develop new technologies in this country, industry experts generally agree that we have more technology available today for manufacturing that we can use in the next 10 years. Our small manufacturing firms are having difficulty competing, not because new technologies need to be developed, but because existing technologies remain underutilized.

Finally I would like to express our belief that advanced technologies do provide an opportunity for the small U.S. manufacturer. Our work in Pennsylvania has indicated that, contrary to popular opinion, those small firms which in fact do use advanced technologies, have shown an increase rather than a decrease in number of jobs in the workforce.

Once again I would like to thank this Committee for giving me the opportunity to testify. And we would be happy to work with you in any way possible.

The CHAIRMAN. We thank you, Mr. Koppel. Mr. McIntyre.

STATEMENT OF ROBERT McINTYRE, CO-FOUNDER, AMPROTECH, INC.

Mr. McIntyre. I appreciate being here today. What I am here representing today really is two companies. First is Amprotech, the company that I spend most of my time in.

Amprotech is a company that specializes in helping small to medium sized manufacturing companies implement, affordably and effectively, automation techniques in their facilities. Our major client, our first client, is Frost, Inc. I used to work in Frost, Inc. and was part of the automation project at Frost.

Frost is a small, very small by automation standards, company that was, when they started the program, was about a $12 million company in annual sales. They had 185 people working there. And they had 72,000 square feet of manufacturing space.

When they began thinking about their automation program they were very typical of many, many small to medium sized manufacturers, in that they were doing very well at that time. This was back in the early 1980s. And they had a good market share. Profits were good.

Everything looked great until they began to look at the future a little bit and see what was going to happen to them and discovered that their existing marketplace was very mature, and they had an inability to do anything about diversification of selling other products.

They had that inability because they were like almost all other small manufacturers, which is one of the problems that is occurring today, is that they spend almost all of their time, 50, maybe more hours a week, looking at, how do I make, how do I sell, how do I engineer my existing product. And I have no time to think about how do I automate my company, which is very, very important, because if they do not keep that simple loop going, they do not have any way to finance the new automation program.

So they are sort of in a catch-22. They know they have to do something but they can not slow up long enough the old ways to change. One of the other Senators asked earlier, was there a requirement for an attitude change in these small companies to do this? There is an enormous requirement for attitude changes inside of these companies.

The installation of tools alone is not going to solve the problem. What happened at Frost was they did use lots of new tools, they spent $5 million on automating their manufacturing facility.

The $5 million included all the tools that were used, all the computers that were used, all of the education or a lot of the education. The State of Michigan paid for a good deal of the education also. And all of the consulting fees.

And that, by a small company's standards, is a nontrivial amount of money to a $12 million company. That is an enormous sum. To today's standards for the expense in automating a company that is next to nothing. But yet the benefits they have reaped because of doing this has been enormous.

Why they reaped those benefits was primarily the attitude change in the management of the company. Not just the use of the tools. Chad Frost, the president of Frost, Inc., is the single reason why that was such a successful project. And not because really that he was such a super smart individual. He is very smart. But the fact that the automation program, the change in this company, happened from the CEO, the president level down.

It did not happen from the engineering department and the manufacturing department and the data processing department upward. It happened with the sword carrying zeal of the president of the company. And we see that that is pretty much true, that has to happen in other small companies.

That is pretty much what, I have got some brochures that talk about what happened at Frost. I think they are a very, very good example that shows, for small to medium sized manufacturers, first of all it is possible to spend a smaller sum of money and reap some significant results, and it is possible, if you spend the time and effort on it, to reap a business benefit of the automation program.

The CHAIRMAN. Let me yield to the distinguished Senator from Michigan. I want to yield to Senator Riegle here. He wants to spread that Frost experience all over the state.

Mr. MCINTYRE. We would like to spread it all over the country.

Senator RIEGLE. Well, we want to help you do that, and I am very impressed. I thought the story that ran in Business Week, which I am going to have made part of the record, is a pretty good summary of what happened. And I wanted to touch on certain items with you.

According to this story one of the things that was done here was to create the separate company, Amprotech, a subsidiary that was really sort of a clean sheet approach to tackling this problem. And I gather, if the tone of this article is correct, that that was an important part of disconnecting it from the dayin and dayout work process to be able to take that detached look at how you might take and really revise the work process. Is that correct?

Mr. MCINTYRE. That is absolutely correct. That was one of the real reasons why this project at Frost was successful. It was firstly successful because Chad Frost was the leader of the program.

But second, the fact that we had enough sense to understand that you had to keep the loop going in that company, of keeping the profits coming into that company, of keeping the daily operations going, and you let a group of people do that and then three of us split off to form Amprotech so that we could think about all of the ramifications of automating the small company.

Senator RIEGLE. Now when you went to Manufacturer's National Bank in Detroit, how enthusiastic were they or your other banking options at the time when you walked in with this plan? Did they think this was a great idea or did it take a lot of selling to make this look attractive to get the $5 million, or whatever part was financed?

Mr. MCINTYRE. All of the above. It took a lot of selling. They thought it was a good idea but we had spent almost a year inside of Amprotech and Frost knowing that eventually this was going to be a debt financed project, for $5 million.

You had to go talk to a group of people who read the papers and understand what they have been reading in that there are many, many large corporations spending hundreds of millions of dollars today and not accomplishing what they set out to accomplish, and they were going to go lend $5 million to a little company that said that I can do it.

You had to spend some time educating these people. And we took them with us to seminars, to trade shows, to all sorts of programs so that when you went to them and justified the automation program, you were not talking something right up front to them that they had some experience and that they understood the terminology, they knew the benefits that could be achieved. They were part of the process.

Senator RIEGLE. That is a very interesting point in my mind, the fact that you really had to sell the financing institution as much as you had to sell the inside of the company, in terms of actually going forward with the changes, and to get that kind of money, because this is basically frontend cost.

Once you come up with a new design it is a front loaded cost situation. And as you say you have got to be able to demonstrate that you can earn that money back and presumably something in addition to that.

What has happened to the workforce? I know your volume has gone up. Your productivity has gone up. Has this had the result of adding workers, holding the workforce about the same, subtracting workers? What has happened in that area?

Mr. MCINTYRE. Several things have happened. The workforce has gone down somewhat, but it is on its way back up again as the company gets bigger. I think there had to be an initial step down before you could begin to build up. Now as this company begins to take on new lines of business that it was totally unable to handle before, now it can begin to add workforce to it.

The most important thing that happened to the workforce, though, was the quality of work that they are capable of doing, that everybody in this company has gone through an enormous amount of education and they have learned the new techniques and they have learned new technologies and how to use it.

They feel a lot better about what they are and even if they left the company to go somewhere else they are a lot better equipped to go work in the new type of environment that is out there today than they were before.

Senator RIEGLE. You know, there was a quote in here along that line that I thought was profound, in the sense it had really captured, I think, a lot of the dilemma that we are experiencing out in the workplace today in terms of people wondering about their own job future and their own skill levels and so forth.

One of the workers is quoted to the effect that after this program was put into place he was enthusiastic about it. "I found out that I am not as dumb as I was beginning to feel," said Terry McGovern, 31, a former screw machine operator who now runs an automated machine tool cell.

That line leapt out at me because I think there are a lot of workers today who want to be able to feel more proficient. They want to be able to feel as if they are growing, that the range of their skills is broadening, that they are able to do more sophisticated things, that their job is not going to disappear one or two or three years down the line, that they can take on the international competition, and feel good about it.

It seemed to me that that quote captured a lot of the frustration that I have heard others express but that he now feels relieved of.

Mr. McIntyre. Well he does, and most of the people in that company feel that way. But we have to remember that it took two and a half years to get them to feel that way. They did not feel that way in the beginning of this program.

Senator Riegle. I have got two other questions for you. In the Grand Rapids area there is a lot of entrepeneurial energy and achievement. It is one of the, I think, areas in the whole country where that is strongly so. I would think that the example that you have generated within your own company would be something that in that environment would be particularly attractive.

I am wondering, as you try to disseminate your story, whether it is through speaking to the Economic Club of Grand Rapids or through the Chamber of Commerce or the Rotary Club, or whatever other vehicles you have to try to go out and say to your peers in the community there, look, this is what we have done, this is how it has worked, and so forth, and we are available to help you do the same thing, if you are interested.

I would think that that is an awfully good place to start selling this to others. What have you found in that respect? It sounds from the article like it is a little slow going at the moment.

Mr. McIntyre. I wish you had not asked that. But what we have found is that Amprotech, the company that is out helping other companies do that, has four or five other clients at the moment, besides Frost, Inc. None of them are from that area. They are all from, lengthy plane rides away.

Senator Riegle. In the United States however.

Mr. McIntyre. Definitely. Nobody outside. We refuse to go do anything outside.

Senator Riegle. Good.

Mr. McIntyre. But we seem to feel that the closer to home you are, it is like the old story, that you are less of an expert the closer to home you are. You know, the prophet in his own land.

Senator Riegle. Just one other thing. In recent years the State government, and Jim Blanchard as the Chairman mentioned earlier, have been very business minded, job minded, economic development minded governor.

We have had a lot of initiatives going, with a strategic investment fund and a variety of initiatives designed to try to make things happen, and particularly to move with technology and to get back out into the forefront of manufacturing and process technology.

Do you know, off hand, or have you found, a mechanism available within state government that could take this kind of process breakthrough or process example and help you disseminate it more broadly to business entities throughout the State of Michigan?

Mr. McIntyre. Sure, the State of Michigan has what is called a Technology Deployment Service, that is sponsored by the Michigan Department of Commerce. They have a group of businessmen who have gone through some of these experiences, like Amprotech was at one point a field representative for the Technology Deployment Service.

Senator RIEGLE. So you do have, then, within the state government structure now, a vehicle by which to go out and put this message out there, and to basically reach other firms of this size so that they know what you have done, what is available and so forth? So that information dissemination is taking place pretty thoroughly, you feel, within the State of Michigan?

Mr. McINTYRE. I will not say pretty thoroughly, but there is a good effort there. It seems to be being disseminated. Where I see the problem is that the mere dissemination of the information about technology does not seem to be changing small to medium sized manufacturers. They do not seem to be leaping on the bandwagon to go become something other than what they are.

Senator RIEGLE. I am wondering if that does not come down to the issue of vision. Now you had a chief executive officer here with vision, who was willing to take the big gamble, so to speak, to go out and raise and invest $5 million on the basis of a concept that you were helping to develop. And now it is working.

You know, that is a big step. There are a lot of companies that, either because they are working day and night just to try to stay where they are, you know that takes a certain kind of innovative spirit and risk taking appetite——

Mr. McINTYRE. I think that is true and on the plane on the way down here I was trying to figure out, how do you get more risk takers in this country to go out and do what Frost did? I think maybe finally when we hit a bump that is the wrong approach. Maybe what we look for is how do we make this appear less risky.

How do we take the risk away from doing what we are doing, and I think that people like the National Bureau of Standards who are already doing such nice work on the use of automated equipment can begin to help take away this risk that is out there.

Then you get the CEO to begin. The CEO is where the problem is. He's not willing to take a perceived risk for next to no reward.

Senator RIEGLE. Well, it sounds to me like you have just given us a very strong argument to let the government do the kind of thing that I think the Government can wisely do. That is to help disseminate information, to help make things that may seem unfamiliar become familiar, to be able to take some of the apprehension out of this process, to make it something that is easier to understand.

I also think the banks have a role to play here. I would think that manufacturers would like to be able to find other places where they could——

Mr. McINTYRE. Same role applies to the bankers, though. If you can begin to reduce the risk in their eyes, they are going to participate more. If it still is looked upon as a risky venture that only a maverick like a Chad Frost would go out and do, then I think you have few and very few bankers who are willing to invest in it.

Senator RIEGLE. Well, I have taken enough time. I thank the Chairman. I have got to go back over to the Finance Committee because we are about to vote on some trade amendments. But I want to commend you and commend the company and I stand ready to help in any way I can as well in terms of being a message carrier for you.

Mr. McINTYRE. We stand ready to help any way we can too.

The CHAIRMAN. Well, I thank you, Senator. There is no question about it. We need this kind of entity in government to assist small business.

I have seen it at the top level, in big companies as well as small. This time last year I saw Kellogg from Battle Creek, Michigan designing a new plant, down in Greenville, South Carolina.

No kidding. They were making the design and they had all the Michigan folks down. They had the engineers, they had the production people. In fact to go through three floors of design work, it was almost like the CIA. They just do not let anybody in to see, because they are big and they are competitive. They are competitive in the international sense, and so they have got to have the best.

But what is going to provide a competitive edge for small firms, other than Amprotech, and a few Amprotechs coming along. We ought to develop more of those Amprotechs through our Institute of Technology, to teach everybody, I think, about the international area.

The financial institutions have got to learn as well as the small businesses that they are in international competition. That is the toughest thing for that leadership that you are talking about, for CEO's to understand.

Because whatever he designs and is made and he is doing pretty well, can be done right across the border in Mexico. And that is why you have got over 300 of the blue chip corporations down there.

So if you come in with a new gadget and you develop your product and everything else in three years, you can find somebody to go across the border to Mexico and bring it back in and copy your product in a couple of years and put you out of business. So you have got to think in those terms.

Mr. Koppel, that is why I was interested in what you were saying about the international nature of competition and production. And then the financial nature, and thereafter, of course, the employees. Like you said, Mr. McIntyre, for a two year period they were sort of resisting. Well, who wants to automate myself out of a job?

I mean, automation might sound good for the boss upstairs, but I have got six more years before I retire or whatever it is, so why should I organize myself into unemployment, is the attitude. And this ignorance and resistance, common sensical, human resistance to losing the job, working your way out of it, it has got to be understood.

Regarding international competition, Mr. Koppel, how do you convince a small businessman that his or her international competition is dangerous, and how do they plan accordingly?

Mr. KOPPEL. Sir, for the small businessman or the small manufacturer, the international competitive question is almost nonexistent. They really do not feel that they are part of an international marketplace.

Most of these small firms market to original equipment manufacturers, and they mostly sell their product within a very small regional area.

We are conducting some work through the Economic Development Administration in Houston, Texas. While helping their manufacturing companies compete more effectively we have discovered that there are some terrific small shops that provide precision machining for the oil and gas industry.

They have never even marketed. All they have ever done is just sat there and waited by the phone for someone from an oil company to ask for particular parts. Now these capabilities could be made available throughout the U.S. But conceptually these companies have never thought about marketing outside Houston, Texas. So marketing abroad is a nonissue, as far as these folks are concerned.

Second, these companies are not really directly affected by international competition. As I noted, most of these small firms are suppliers to the larger corporations. Those are the ones that are affected.

But what has happened is that the larger corporations, the IBMs, will as prices go down, ask their suppliers to provide them with parts and components at lower costs.

This is where the small guy is in a fix because he still has antiquated equipment. He can not reduce his overhead costs any more. And the only way he can really provide these lower costs is through more advanced technologies. So he is caught in a real bind there.

The CHAIRMAN. Right, and these parts for IBM are being made in Singapore. I see it in my own state, I saw your automobile industry, Mr. McIntyre, out there in Michigan, go out of business in the sense of not only just having lost the auto plants in Detroit, but also auto parts.

We do not manufacture many American cars anymore. We assemble foreign parts. We think it is wonderful to open up a plant, but I see the parts coming in in pilot form right on the docks in my own home town.

Yes, you can start manufacturing as a small business making component parts, whether they are for a computer or an automobile or a machine of some kind, but as you succeed you get to a point where in order to continue with that contract you might get that supplier to move offshore and get it even cheaper, unless you automate in order to continue to supply that particular part.

So they do not see themselves in international competition, but they are.

Mr. KOPPEL. But they are. Absolutely, sir.

The CHAIRMAN. Mr. McIntyre, you mentioned the financing from the State of Michigan. I want to know about the EDA participation. You had to convince the Department of Commerce, you had to convince the government in Michigan.

How about Michigan? What percentage or proportion of state financing did we have for that Frost operation?

Mr. MCINTYRE. That was entirely financed through an EDC bond issue, which the bonds were then sold to local banks.

The CHAIRMAN. So in other words the full faith and credit of the State of Michigan guaranteed bond.

Mr. MCINTYRE. Correct.

The CHAIRMAN. But they do not just come along and guarantee any and everybody's bond. So you have got to educate that group, do you not?

Mr. McIntyre. We have to do a lot more than educate them now. That EDC bond issue is a thing of the past. It is not available for small companies anymore. It was a good way for small companies to finance their programs.

The Chairman. Why was it eliminated?

Mr. McIntyre. I can not tell you that. I do not know that, sir.

The Chairman. That gets me back to Michigan being financed by Japan. I remember when they put up a $500 million line of credit at the market at New York. That was about 10 years ago, I think it was, the Japanese banks that invested in it.

Well, how about the EDA, the Economic Development Administration? What proportion did they have of the financing?

Mr. McIntyre. I am not sure even what that refers to.

The Chairman. The Economic Development Administration, I thought somewhere along the line——

Mr. McIntyre. Well, there was an Economic Development Corporation in the——

The Chairman. Oh, the corporation in Michigan, not the Economic Development Administration.

Mr. McIntyre. They did not lend any money. They provided a lot of assistance to Frost in getting through the red tape and the analysis of what has to happen to get the bond issue through.

The State of Michigan was enormously important to Frost in getting the automation project done. Not by ensuring the technologies were there, but they did a lot to help in the education of the employees.

The Chairman. But I understand that the original study on the automation came up to the range of $15 million, and you brought it down to $5 million.

Mr. McIntyre. The original quotes from a variety of vendors went from $12 million, $15 million, one of them even as high as $30 million to automate a $12 million company.

The Chairman. And what was the final cost?

Mr. McIntyre. $5.1 million.

The Chairman. How do you explain that? Was it just through caution and inexperience, with the original bidders not really knowing or understanding and wanting to make certain they do not lose so they put the cost up?

Mr. McIntyre. Well, the original vendors were in business to do one thing, and that was to sell their product line. And they wanted to sell lots of it. They did not understand that the role of a small company was to reduce his cost of manufacturing.

Most technology in automation today that is going on does not address itself to reducing the cost of manufacturing. The successful projects that you see out there are being viewed successful when they go, that they do not make product any cheaper.

But what we concentrated on at Frost, we said that if the tool of automation does not directly lead to reduced break even, do not install it.

The Chairman. Now you are telling me that automation does not reduce the cost?

Mr. McIntyre. I am saying that automation has to reduce the cost. I am saying that many times we have not seen it happen in uses of technology today. We get too enamored with the technology for itself. We do not demand a business result of it.

The CHAIRMAN. It seems that if I were in the manufacture of automation equipment, that that would be the sine qua non.

If I did not design a machine that was going to reduce the cost, I do not care how much automation I had, how expert and fine and technologically super it was, I was not, because I have got to sell that automation on the basis of the customers' reduced costs. I have got to go to that customer and say, look, this is good for you.

Mr. MCINTYRE. Many pieces of automation today are being sold because they are neat.

The CHAIRMAN. Because they are what?

Mr. MCINTYRE. They are neat. People are buying automation for the wrong reasons today.

Mr. KOPPEL. Sir, there is a big difference between technology and automation and manufacturing. And it is that gap that a lot of the manufacturers of equipment really do not appreciate.

The CHAIRMAN. Well, we really are indebted to both of you. We appreciate it.

So the Committee thanks you at this particular time and will be in recess.

[Whereupon, at 11:15 a.m. the hearing was adjourned.]

TECHNOLOGY COMPETITIVENESS ACT OF 1987

TUESDAY, MAY 19, 1987

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee convened, pursuant to notice, at 2:05 p.m. in room SR-253, Russell Senate Office Building, Hon. Ernest F. Hollings (Chairman) presiding.

OPENING STATEMENT BY THE CHAIRMAN

The CHAIRMAN. The Committee will please come to order. We are pleased this afternoon to look at the Technology Competitiveness Act, and we have a submission by our distinguished colleague, the senior Senator from Arkansas, who has a similar bill in S. 930.

Senator Bumpers, in this initiative, what I and the Committee are trying to do, and your bill is very helpful, is to develop a culture, similar to the agricultural field that we are very familiar with. We have agricultural research sponsored by the government, extension services, economic information, price and stabilization, rural development assistance, export promotion, right on down the line.

It has worked extremely well for being only 3 percent of our GNP. For America's agriculture, we appropriate something like 860 million bucks.

In contrast in industry, we did not do this, we had no intention of doing it. We left it to the free marketeers, private free enterprise. But we understand now that in the international economy in which we live that it is largely government to government enterprise. So what we need now is to develop a culture without disturbing the free enterprise nature of our own domestic market. We must develop a culture and an assistance program so that our technology, if nothing else, can be developed and commercialized.

I would like to help with the research. We have already had the National Science Foundation testify. We can start by putting out science centers at the various university levels like you and I did with the land grant colleges in Arkansas and South Carolina. Then by following with a change of our National Bureau of Standards into a National Institute of Technology, we can assist further.

Then with some small loans, at least for the small businesses and medium sized businesses, to let American business know that they have the government on its side without disrupting the law of supply and demand and economic initiative and what have you.

We think this is absolutely necessary. We see how down at the University of Houston we developed the superconductor, we discovered it. The Japanese in 48 hours formed a consortium to develop and commercialize it. We will find out this time next year that the Japanese have the profits and we have the Nobel Prize. We will run around crowing about what a great crowd we are.

With commercialization they will come back with profits and put those profits back into research in Japan. You see in South Carolina there are 13 Japanese industries, I love them. But my trouble is they are taking profits back and putting it into research in Japan. They are not bringing Japanese research over here. See what I am saying.

So what we need is your bill and any others that can join in. We will resolve some measure to report to the floor. After a few years of going along in a cautious fashion, we are not now going overboard economically. Japanese businesses will get $860 million for 25 percent of GNP and, I would say we are not spending more than let us say a little over $100 million at the Bureau of Standards if you want to count that in the way of comparison.

It is up to the government now to start producing and start competing. With that we welcome you and Senator Rockefeller, do you have any comments?

OPENING STATEMENT BY SENATOR ROCKEFELLER

Senator ROCKEFELLER. Mr. Chairman, thank you for holding this hearing this afternoon so that the committee can hear further testimony concerning the Technology Competitiveness Act of 1987. As a cosponsor of this measure, I welcome our principle witness, the Undersecretary of Commerce, who can advise us about ways to encourage industry to turn the fruits of our basic research into marketplace products. I also welcome the opportunity to discuss strategies for commercializing technology with the President of the U.S. Ceramics Association, the President of the Industrial Biotechnology Association, and Professor George Heaton. Additionally, I'm pleased that my colleague Senator Bumpers is lending his considerable skills to the technology effort. I look forward to hearing his remarks today.

Mr. Chairman since this committee last met to discuss S. 907, I have had the pleasure of visiting the National Bureau of Standards. The Bureau is a truly impressive institution—one that all of us should see firsthand.

One of the scientists who I met during my tour of the Bureau, a Mr. Ron Fleming, told me a very instructive story about his research. Recently, Mr. Fleming attended a conference on the west coast. He decided to stop in and see some of the semiconductor factories in the Silicon Valley. While visiting one particular plant, Ron Fleming was told that there was a problem with the quality of the semiconductor chips being produced there. Mr. Fleming offered to look into their problem when he returned to the Bureau. Once he returned to the Gaithersburg facility, after only 2 hours of work, Ron Fleming discovered that the glass coating on the chips was defective and that the company's processing technique was causing this defect. The company simply had to alter the amount of heat they used in their processing conditions. With Ron Fleming and the Bureau's help, this company has now increased their productivity many times over.

Ron Fleming's story is an important one because it shows us how technical expertise can facilitate production. If Mr. Fleming had not taken the initiative of visiting this particular semiconductor facility, they may have never perfected their batches. Frankly, American industry needs more Ron Flemings going out to small and medium sized businesses to provide the technical know how.

How many companies in this country know about the National Bureau of Standards and their hundreds of highly trained scientists? How many know about the cold neutron reactor that is being built at the Bureau and how this reactor could help their work? How many companies are aware of the automated manufacturing facility at the Bureau?

To be sure, many of our big companies work closely with the Bureau—our IBMs, Hewlett Packards, and Xeroxes. But what about our small and medium-sized businesses? They, too, must know how to use advanced technology to their advantage.

Senator Hollings' bill attempts to get at this problem of transferring technology to small sized businesses. There are other proposals that are also worthy of this committee's consideration including Senator Bumper's bill and a technology extension bill that I am currently looking into.

I look forward to exploring these different legislative approaches with this committee.

Obviously I am very much looking forward to what Senator Bumpers has to say, particularly with respect to making this all more effective in our own states. I also co-sponsor Mr. Chairman, your Technology Competitiveness Act of 1987 and I am looking forward to what we are going to hear this afternoon.

I think part of what I am expecting to hear from Senator Bumpers and what I know is in your own bill Mr. Chairman, has to do with this. This is our greatest efficiency, you just mentioned it. We have the Nobels, they have the process. They have the jobs.

We have to find this way of making one work with the other. Out at the National Bureau of Standards they are showing us the automated factory of the future. You go out there and you could just watch robots talking to machine tools talking to computers. That is what is going to happen. We have 120,000 factories in this country were there are machine tools on the floor and 80 percent of them employ less than 50 people which tells me that in ten years if we do not catch up with somebody those folks are not going to be working.

It is out there, and what we are trying to do here is make it more available to people who are willing and want to use it. So I applaud what you are doing. I am interested in all of our witnesses. I am interested in hearing what Under Secretary Bud Brown has to say, and obviously Senator Bumpers as your first witness Mr. Chairman.

The CHAIRMAN. Senator Bumpers, we welcome you and are glad to hear from you.

STATEMENT OF HON. DALE BUMPERS, U.S. SENATOR FROM ARKANSAS

Senator BUMPERS. Thank you Mr. Chairman. Let me say first of all I ask unanimous consent that my short and full statements be inserted in the record. With your permission, I will extemporize.

First I want to say that this bill, S. 930 is not designed as a massive, Federal approach to the problems of innovation and technology and productivity. It is an embryonic beginning of a decentralized, local approach which certainly the Chairman and Senator Rockefeller and I all can understand. Senator McCain, this is not meant to exclude you but you are looking at three former governors here who learned a long time ago that the fountain of all wisdom is not located in the city of Washington.

This bill is designed to take advantage of something the states have been doing for some time now and doing extremely well, namely working to enhance the competitiveness of the firms located in their State. The bill simply establishes a clearinghouse here in the Office of Productivity, Technology and Innovation in the Dept. of Commerce. There's no pride of authorship about where the office ought to be located. We looked at the Bureau of Standards and a couple of other places where this clearinghouse could be located, but it seemed to us that that O.P.T.I. was the more appropriate place for it to go.

What I am hoping Mr. Chairman, is that this bill might be tagged on as an amendment to your bill, S. 907. S. 930 is not a flashy idea. It is not a particularly new idea. It is simply designed to recognize a number of things.

Number one, an overall single approach to competitiveness from Washington will not get much done. It seems to me that what is needed is a firm-by-firm approach. The states have recognized this for some time.

Above all the states have done something that we here in Washington have refused to do. We cherish the separation of church and state. We debate it every time the prayer in school issue comes up. We have built up a tremendous barrier there which Jefferson said that we had to maintain. But some have carried that over also into the economic areas of this country by saying that the private sector can do everything better and the public funds and programs ought not to be comingled with private enterprise.

Yet we are competing against nations, and competing poorly with nations which take the very reverse position. The Japanese government does not hesitate to pour money and expertise into a new idea if it is going to help their exports or if it is going to help them become more innovative or more productive.

Productivity is crucial and I have introduced a separate bill, S. 932, which I might just mention here in case you all want to jump on it. It is a bill that has been referred to the Senate Finance Committee. It deals with cash profitsharing.

I am a strong believer in profit sharing. And you know, the truth is it is the employees of this country, not the employers, who resist the concept. We are trying to make it so that it is enticing to both employers and employees to participate in a profit sharing plan.

My sister, who is the wealthy member of our family, turned Republican as soon as she made her first million.

She made her money by sharing her profits with her employees many years ago. Friday afternoon I was going out to Akron, Ohio to speak for former Representative John Siberling and I was seated by a couple of fellows there from a small boat manufacturing plant in Berea, Ohio. It is a total ESOP. I picked their brains all the way out there about how ESOP's and profit sharing works.

Russell Long has been the patriarch of ESOP's at least ever since I have been in the Senate and I would like to take the mantle over from him because I so strongly believe in the concept of ESOP's and profit sharing. We are talking about productivity. Incidently, productivity is as important in competing as is innovation and new technology. The more productive we become, the cheaper the product is and the more attractive it is in foreign markets.

But profit sharing is a separate name. This bill really goes more to the area of productivity, technology and innovation. As I was saying, the states have not been afraid to break down that barrier between private and public funds and between foundations and universities. With all of them pooling their information and their intelligence, they can help to make the businesses there more productive and more innovative.

My State is always in a fight with some other State to give tax advantages to whoever says they will build or relocate a plant in my State. I can understand why any Governor of any State would get involved in that kind of bidding. If I were still Governor, I would too. I would not let the people of Arkansas think that I was sitting on my duff while Tennessee was offering every kind of advantage under the shining Sun to persuade General Motors to locate its new Saturn plant there.

I can tell you, we in Arkansas cannot compete in that market. Some State is going to outbid you. What I have always believed is that we ought to be more careful to take care of the firms we already have in our State, rather than go help the ones which who are only a promise. This is particularly true if we have to give away the store to get them.

This clearinghouse proposal is funded a very modest level, $2 million for openings, no more than $4 million anywhere down the pike. It would look at what the States are doing and with the permission of the States and local governments, analyze what they are doing and which approach is the most effective.

We may at some point see something that a State cannot finance at a level that it ought to be financed. If we think it is good enough, the Federal Government might provide funding.

I am not one of those guys who say "no more new programs"; "you cannot do that because the deficits say you cannot do it." If we are going to sit on our laurels, we are not ever going to become competitive. There are times where government does have a role in enhancing the competitiveness of our country.

Senator McCain if you will pardon me just one minor partisan indiscretion, I think the most irresponsible thing President Reagan ever said as a candidate was that "the government cannot solve your problem because government is the problem." There is just enough truth in that to give him a great deal of credibility. But this idea becomes the rule rather than the exception. And the truth of the matter is that government does have a positive role.

We need to start breaking barriers down and joining hands with the private sector and foundations and universities. Maybe we should do it not just at the state level but at the regional level. The Southern Growth Policies Board, an organization in which the Chairman has been as actively involved in as I have been, have a lot of ideas about how to approach competitiveness on a regional level.

With this clearinghouse we do not want to duplicate the small business loan program. We do not want to duplicate a lot of other things that the Department of Commerce and Small Business Administration are doing. But this clearinghouse is not duplicative. With it we are simply saying "we can learn something from the states."

Mr. Chairman, I do not want to fill the records with these reports on State efforts and I just want to refer to them. Here are a whole host of publications on what the states are doing. They have been very good at enhancing competitiveness.

You and I both know for example, if you close a shoe factory in Arkansas, you can't talk about retraining anybody, because there is nothing else for them to do there. When the shoe plant closes, the town goes down.

There may be some things that you can do that would cost you less than trying to retrain their workers. You could help somebody with an embryonic idea get a business started in that community.

I do not want to belabor my point and I know this committee is busy. I just want to simply make the point that I think there is much we can learn from the states. I think with the modest amount we are talking about here, the clearinghouse is a risk worth taking. I think the benefits and the dividends might be very great indeed.

The CHAIRMAN. Let me ask this, because this is exactly what we have in mind for the National Institute of Technology. In other words the Bureau of Standards is fairly wide awake, but the leadership in Commerce has certainly not been wide awake.

The Bureau of Standards for example, has developed the technology for a project we are now doing. The building of the plant and everything else for a RAMP project, Rapid Acquisition of Manufactured Parts. The Stanford Research Center, Grummond Aircraft, our own research center, two or three other industries have joined to use all of this technology to take, and immediately produce, manufactured parts by computerization. Thus, for the U.S. Navy we will bring a ship into port and get it back out, repaired in 20 days rather than 200 days.

All the other defense industries and large industries are definitely interested and they are all working and sending teams to monitor what we are doing in South Carolina. This is big aircraft and big defense industry, but what Senator Bumpers is talking about and I am interested is smaller industry. Like I was trying to parallel to the agriculture problem, when that farmer is not doing too well or he needs advice he can go to that farm agent in his county and talk about insecticides or what is done with the drought and everything else. He knows and he gets immediately that culture that has developed the best of advice. In a similar fashion, if the Institute of Technology could do the same using the Department of Commerce which has all this kind of information. An established business, industry, what have you, could learn what corners could be cut on the cost of production. Or how they could modernize, how they could computerize, or how they could become more productive.

That is what we have in mind. Would there be any objection if that kind of office or entity was in that same Institute of Technology, do you see any objection to that?

Senator BUMPERS. Mr. Chairman, as I noted a moment ago we looked at all of those. We simply thought the OPTI would be a better place.

As I say, we are not hung up on that. If I may Mr. Chairman just add one other thought that is slightly different from what you are talking about.

In your opening remarks you said something that I intended to discuss. We think nothing of spending hundreds of millions of dollars a year to conduct research to help farmers. We have the extension service and you have every kind of grain research under the shining sun. The State of Arkansas spends no telling how much money at the University of Arkansas to improve our rice strains. Rice, poultry and catfish are three fairly unique agriculture products in my state. We don't hesitate to get the government deeply involved in enhancing the productivity of the farmers for these products.

In catfish farming, we have the Federal Government involved. Just to give you an illustration, you tell me, do you think government had a responsible or a legitimate role in helping. Catfish farmers? When the government starting helping us figure out how to raise catfish, we were raising 700 pounds of catfish per acre per year. Today there are farmers who raise as much as 4,000 to 5,000 pounds per acre per year because of the research the federal government paid for.

I do not want to belabor that, but I am just simply saying it is an interesting thing what a paradox it is. We have no objection at all to spending hundreds of millions of dollars to help farmers and agricultural research. But the minute you start talking about that kind of money for innovation and technology improvements in manufacturing, people say you are going across the line. You are interfering with the capitalistic system. That is nonsense.

The CHAIRMAN. You are right on target. Senator Rockefeller?

Senator ROCKEFELLER. No questions.

The CHAIRMAN. Senator McCain?

Senator MCCAIN. Thank you. I appreciate the, as always, very persuasive and eloquent statements of Senator Bumpers. I also happen to have had the privilege of knowing his sister who is not only smarter, but a lot better looking, I might add.

Senator BUMPERS. She is like all those Republicans, they think because they are rich that they are smart.

Senator MCCAIN. I will not try to respond. Senator Bumpers, there are a couple of important things you are saying here, including I think it is worthy of note that the National Governors Association has endorsed this bill.

It seems that more and more we are finding new and innovative ideas coming from the States and the local areas. I think we could find that to be true across the board from alternatives to Medicaid to Workfare to many other programs which we seem to be unable to grapple with here in the Congress unfortunately.

I also share your concern about what happens when industries die. The State that I represent has felt the significant impact of the death of the copper industry where entire towns in rural areas are basically shut down and certainly job training programs have to have a lot more than just job retraining.

I believe that it is also an untapped area. I also would comment that your statement about the competition between States is so important. I remember when Admiral Inman was going around the country and deciding where to locate. I, in all fairness to our friends from the State of Texas, believed there was no way that a small State like Arizona or Arkansas was going to compete with the State of Texas for that great resource. We have to be on much more of a level plane. I believe we can achieve this through your bill. I am amazed at how little money that we were talking about here, $2 million.

I would hope that we could act on this at least very quickly and try and begin what could be one of the ways to attack the very difficult issue of competitiveness and technology. Thank you.

The CHAIRMAN. Senator, you got me thinking along those lines and we have to give Arkansas credit for it. We have passed the veil or breached the wall with respect to agricultural industry. I was down in the duckblind, this was 20 some years ago with Oliver Willets and Beverly Murphy from Campbell Soup. South Carolina grows a lot of truck farming in the lower country so I wanted to get a soup factory. They came back and said the cost of producing the stainless steel in South Carolina which would be needed for just one crop of tomatoes was just too much. They would have to go to Texas where they had controlled irrigation, sunshine, two or three crops a year. But they said do not be discouraged governor, if you can produce poultry like the State of Arkansas, they said we might get you a plant. We now have Campbell's Soup, who was later taken over by Pepperidge Farm in Sumpter, South Carolina. It is a magnificent plant, and we got it by going around, we got Clemson out and we went buck, buck, bucking like a chicken all over the countryside.

In 1960 we had about $19 in poultry income. Now 26 years later, we had $267 million, that is bigger than tobacco. It is there because of government. The government got it together and got everybody together. And they allowed that for an agricultural industry, why not just allow it for all small industry and other businesses to get us more competitive and more productive rather than giving up on people by thinking that the American people have lost their steel.

It is the government up here. What happened out at the Persian Gulf, I can give you the answer, the process is flawed. You lose astronauts, the process is flawed. You lose Marines, the process is flawed. You lose the Moscow embassy, the process is flawed. You lose these seamen on the *Stark,* the process is flaw. They have made irresponsibility an art form in the administration, and it is used against the government. They follow through in that mentality that you remarked about the government being the problem.

I appreciate it. Thank you very much for your presentation.

Senator **Bumpers**. Thank you Mr. Chairman, Senator McCain, Senator Rockefeller.

[The statement follows:]

Statement of Hon. Dale Bumpers, U.S. Senator From Arkansas

LEARNING FROM THE STATES ON COMPETITIVENESS

Mr. Chairman and members of the committee, I am delighted to appear today to discuss how we can help to make America more competitive.

Let me begin by saying how pleased I am that Senator Ford, Senator Gore, and Senator Inouye have agreed to cosponsor the proposal I have introduced in the Senate, S. 930, to establish a clearinghouse on State and local competitiveness initiatives. I am hopeful that the substance of this bill can be included as an amendment to S. 907, Chairman Hollings' proposal, which I understand may be the committee's contribution to the omnibus trade and competitiveness bill in the Senate.

Pragmatic middle ground

In the current debate on how to assist our industries and businesses to regain their competitive edge in the international marketplace, there is very little concensus here in Washington on how to proceed and the massive Federal Government budget deficits severly constrict our options.

The debate on competitiveness is laced with ideological issues about the proper role of the Federal Government. Unfortunately, the debate often focuses on the extremes, with advocates on the one side arguing that the Federal Government should do nothing and advocates on the other arguing that the Federal Government should intervene actively in the marketplace. I believe firmly that there is a pragmatic middle-ground in this debate which has not been fully explored.

We can, for example, take a positive and constructive step which does not involve establishing any new Federal policy or which drains the Treasury. We at the Federal level of Government can play a constructive role which does not impose a top-down national industrial policy. The Federal Government need not become a lender of last resort to every business which is adversely affected by international competition.

Specifically, legislation I introduced on April 7, S. 930, would establish a national center in the Commerce Department to serve as a clearinghouse to monitor and assist State and local governments with their initiatives to stimulate productivity, technology and innovation.

The Center on State and Local Initiatives on Productivity, Technology and Innovation will help all of us to enhance the competitiveness of our country in international trade without erecting new trade barriers to imports or launching massive and untried Federal Government programs.

This modest proposal will help all of us to learn from the practical programs that State and local government agencies are undertaking to assist our industries and businesses to regain their competitive edge. The Center's service as a clearinghouse will help the State and local governments to learn from one another about which of their initiatives are the most effective and most cost effective and it will be valuable to those of us at the Federal level who are seeking to develop a concensus on how to proceed on this critical issue.

We have choices other than doing nothing and doing too much. We need not ignore the issue, as this administration has done. We can pursue a multi-faceted, bottom-up competitiveness strategy. We can avoid centralizing the strategy-making process. We can be pragmatic, we can avoid ideology and we can come together as a Nation to do what makes sense and what is necessary to advance our national self interest.

We do not have to wait until there is a concensus at the Federal level about how we can be helpful in enhancing competiveness. The State and local governments are not waiting for the Federal Government to address the challenge of competitiveness. They know not to expect action from this administration.

A clearinghouse can be helpful now and it is the minimum step we should take to inform ourselves and support those who are not able or willing to act on a critical challenge to the economic well-being of our Nation.

State and local government initiative

On the issue of competitiveness, State and local governments are demonstrating much more creativity than is the Federal Government. They are showing that they understand how serious the competitiveness challenge is for America and they are acting boldly and pragmatically to bring the public and private sector together in a constructive partnership to meet this challenge.

Many States and local communities are establishing business "incubator" centers for entrepreneurial activity, often in conjunction with State universities and private for-profit corporations. These centers are designed to nurture small businesses by lowering their overhead costs with shared support services and providing on-site management assistance and support. There now are at least 148 centers in 33 States. ("Incubators: A Small Business Case Study," Washington Post, June 30, 1986.)

Regional organizations are coming together to fund shared flexible manufacturing facilities, which are capable of making a wide variety of products, with leases for production time being given to various small businesses. The National Governors Association, the Western Governors, Association and the Southern Growth Policies Board have been active in organizing competitiveness initiatives on a national and regional basis.

Arkansas has a science and technology authority, New York has a science and technology foundation, Michigan has several centers of excellence, and Pennsylvania has a Ben Franklin partnership. Ohio, Illinois, New Jersey, Kentucky and many other State are active in promoting competitiveness. They are not waiting for the Federal Government to step in with funds or programs.

There are at least forty-six States with customized training programs on a firm-by-firm basis for new or expanding companies. Under these programs the State schools and universities work with private employers to deliver the required training. These training programs can be used to introduce more productive technologies to those in training.

The range of initiatives is so broad that there is no comprehensive list of the initiatives which have been undertaken by State and local governments to enhance competitiveness. There are some useful resources which document the range of these initiatives but none of them is comprehensive.

The National Governors Association has published one useful compendium, "Revitalizing State Economies: A Review of State Economic Development Polices and Programs."

The Office of Technology Assessment has published another, "Technology, Innovation, and Regional Economic Development."

The Committee for Economic Development has published "Leadership for Dynamic State Economies," the President's Competitiveness Commission issued "Innovations in Industrial Competitiveness at the State Level," the American Association of State Colleges and Universities has published "The Higher Education-Economic Development Connection," the Commerce Department has issued a "Guide to Innovation Resources and Planning for Smaller Businesses," and the Small Business Administration has documented "State Activities in Venture Capital, Early-State Financing and Secondary Markets."

But, the range of these initiatives is too broad, the programs are changing too quickly, and the Federal Government has too little interest in monitoring these developments for us to have even a complete list, let alone an understanding, of what is happening now at the State and local government level.

We do know enough, however, about these initiatives to know that something exciting is happening at the State and local government level. We know they are experimenting with new approaches to the responsibilities of government, we know they are taking risks, and we know that they are challenging the traditional notions about the relationship between the public and private sector. Clearly, we need to know more and a national clearinghouse is the logical first step in educating ourselves about what already is happening.

States are more pragmatic

It should not be surprising that State and local governments are taking the lead on the competitiveness issue. State and local governments have intimate knowledge of what the decline in competitiveness means to the workers and managers in their region. They know what happens when a firm cannot compete in the international marketplace or when it determines it must relocate its firms overseas to take advantage of lower wage costs. They can see businesses struggling to adjust to changed markets and new technology. They see entrepreneurs with an idea who cannot obtain capital or who need assistance in commercializing an invention.

State and local governments know that under the current administration and with the huge Federal budget deficits, they cannot wait for Washington to formulate or implement a competitiveness strategy for the country. They know that their only alternative is to act on their own, using their own resources and relying on their own good judgment about what role government can play.

State and local governments are in much healthier fiscal shape than is the Federal Government. State and local governments taken as a whole are running a budget surplus, which contrasts starkly with the abysmal deficits we are running at the Federal level. Because of the irresponsible fiscal policies of this administration, at the Federal level we simply do not have the funds to appropriate for new initiatives, or even to provide adequate funding for existing programs in the areas of education, trade adjustment assistance, and export promotion. Our national economic well-being is threatened and we have been left with insufficient resources to make the investments which are necessary to meet this threat.

Most important, State and local governments are finding that they can play a constructive role in stimulating productivity, technology and innovation. They do not have a rigid ideological suspicion of everything that comes from government as does the administration in Washington. They're not concerned about ideological purity; they're just trying to solve problems. They don't throw around slogans about "Government Being the Problem." They see a problem and they go to work.

State and local governments are sensitive to what government can provide in the way of assistance and they know how government intrusion can do harm. They can adjust programs when they fail or when they can be improved. They seek feedback and listen better than can any Federal level program.

State and local governments see that the distinction between public and private institutions is becoming blurred. They see that the distinction is no longer as great between public education institutions and corporate training programs, between types of financial institutions or communications technologies, between basic and applied research, and between physics and math.

We now have both governments and businesses which conduct research. We have profit making organizations which perform important charitable services. We have corporations which provide health care and health insurance. We have banks which sell stocks. It is outdated and naive to assert that the private sector and the marketplace are the sole players in economic development.

State and local governments know that it is simplistic and counterproductive to assert that government "is the problem." Government certainly can create problems just as can a private business when it is poorly managed. We at the Federal level have made major mistakes in setting macroeconomic policy. But for good or bad, governments are here to stay and the issue is how well they are managed and how constructive the role is that they play. Government can be a partner or a meddler, but it is always a factor.

State and local governments are taking risks with these innovative programs. They are conducting experiments and we must understand that some of these experiments will fail. Some public money may not be invested wisely in searching for effective ways to stimulate productivity, technology and innovation. Some of these programs already are subject to controversy and there is always controversy when taxpayers' funds are not invested with a maximum return. But, government institutions need to take risks just as do corporations. New products introduced into the marketplace by corporations fail, indeed most new product introductions fail. This doesn't lead corporations to stop introducing new products. If government refuses to take risks and refuses to try innovative approaches to pressing national problems, it may well become more of the problem than the solution.

We need to experiment with partnerships and new relationships between the public and private sector. We need to learn even if that sometimes means learning from a mistake.

With a national clearinghouse we all can learn more from experiments which others already are willing to undertake. The clearinghouse itself is a modest experiment given the willingness of State and local governments to fund and conduct—and take the heat for—experiments in enhancing competitiveness. In seeking to determine which experiments are succeeding and which are not, hopefully we all can avoid repeatedly making the same mistakes.

With respect to the role of the Federal Government, my legislation is based on the premise that the Federal Government can have a significant impact in promoting the competitiveness of our country simply by helping State and local governments to continue their efforts and to learn from one another. This is minimal role, but it is one that can provide us all with vital information. Without this information, we at the Federal level will continue to flounder, continue to act indecisively and continue to debate the issue of competitiveness in the abstract.

With a clearinghouse we are acknowledging that the Federal Government is not the only, and indeed it is not even the major, actor in enhancing the competitiveness of our business sector. There are 50 State governments, thousands of city and country governments, thousands of universities, thousands of foundations, thousands of non-profit institutions, and thousands of private corporations which can take the lead. We need all of them to play a constructive role and we at the Federal level need to do all that we can to stimulate diverse approaches to the competitiveness challenge. It would be folly and unwise to pursue one single, national, and federally-mandated strategy.

Need for a clearinghouse

S. 930 would create a center on state and local initiatives on productivity, technology and innovation. The center would be located in the Commerce Department and its principal function is to serve as a clearinghouse on the competitiveness initiatives of State and local governments, regional organizations, university and private sector cooperation, and joint public-private sector partnerships.

The President's Commission on Industrial Competitiveness studied the efforts of State and local governments to boost competitiveness. In a report to the Commission prepared for the task force on State and local initiatives by SRI International and the Chemical Bank, it is recommended that "a National Resource Center should be established to identify State innovations, assess their effectiveness and promote action by States and industry." ("innovations in industrial competitiveness at the State level," report to the President's Commission, SRI International, December 1984, at 70.)

This report found that "States, industry, and the Federal Government all need better information on which of the strategies attempting to promote industrial competitiveness at the State level are working." (Report at 70.) It found that only a "limited amount of systematic effort" had been made to "document and assess what has been happening." (Id.) the recommended "National Resource Center" could "serve as a national clearinghouse, a neutral forum for discussions among sectors and a resource for technical assistance for states or industry interested in developing new strategies." (Id.)

Similarly, the Congressional Office of Technology Assessment found that to provide direct or indirect assistance to State or regional high technology development, it would be helpful for the Federal Government to establish an information clearinghouse "containing a comprehensive and up-to-date list of State and local initiatives" that support high technology development. ("technology, innovation, and regional economic development," Office of Technology Assessment, July 1984, at 11.) The report found that the most helpful type of information the clearinghouse could assemble would be a "project bank" such as that established by the White House Task Force on Private Sector Initiatives.

With the information which a clearinghouse can assemble, we in Congress and the exective branch can determine to what extent this recommendation has validity. We certainly need to know much more about the initiatives of State and local governments before the Federal Government should lend its financial resources to these State initiatives or organize similar initiatives at the Federal level. The center is not authorized to provide financial assistance to the State and local government agencies to fund the initiatives which are being undertaken. (Section 5A(I)(1)(A).)

The clearinghouse is modest compared to the calls in recent years for a national industrial policy. Here in Congress several years ago we debated various proposals, some of which have called for direct Federal funding of "sunrise" and "sunset" industries through some sort of natinoal development bank or finance agency. Many commentators weighed into that debate and the debate became quite ideological and polarized.

The proposal for a national development bank was the most controversial of the industrial policy proposals. In my view, it is not clear whether such a Federal bank could identify with any confidence which industries are the most likely to succeed in the international marketplace. This issue is being confronted, however, at the State and local level and we can learn whether there are any sound criteria for determining how to allocate government resources, both financial and nonfinancial, to have the greatest impact. I am doubtful that there are but we can learn from the approaches taken by State and local government agencies in making these investments.

My proposal to establish a Federal clearinghouse is a much more modest proposal than the proposal for a national industrial policy in its cost. A clearinghouse is not expensive. It does not invlove establishment of any national development bank. A clearinghouse is not intrusive. It does not ask the Federal Government to "pick winners and losers." The clearinghouse is not an Agency which will become politicized or besieged by special interest pleaders seeking access to trade protection, financial support or exemptions from Federal Government Regulations. The clearinghouse is a facilitator, not an dominanting force.

Federal Government has much to learn

I also want the Federal Government itself to learn from the experience of State and local governments. In fact, the Federal Government itself could be one of the principal beneficiaries of the efforts of the center, along with the State and local governments which can learn from one another.

It is important for the Federal Government to examine what the State and local governments are doing because the Federal Government is struggling to decide what it can do about the competitiveness problem. We need to act, but we need to act wisely. The power of the Federal Government can be used creatively and constructively, but it can do harm as well.

I believe that the clearinghouse will find that State and local governments are developing effective and cost effective ways to target their efforts to enhance competitiveness. If the clearinghouse finds this to be true, these lessons can be applied at the Federal level and they will be of importance for use here in Congress as we examine proposed initiatives for the Federal Government.

We may find that there are some areas where new programs at the Federal level are clearly appropriate. We may find that the principal need is for additional resources to be put into the most successful existing programs, particularly in the area of education, in funding basic research, and in responding to unfair trade practices of foreign competitors. Or we may find that wholly new approprches are needed. Funding for some programs may be better spent on other efforts or not spent at all.

If the Federal Government undertakes new initiatives to enhance competitiveness, it is important that these initiatives be well conceived. We do not have to reinvent the wheel at the Federal level. But, just as important, we need to know how any Federal program relates to existing programs at the State and local level. We need to ensure that the Federal Government does not trample on the efforts of other levels of government.

With this clearinghouse we in Washington may discover new ways in which the Federal Government can become more helpful than it is now. We certainly can learn from and avoid the mistakes made by State and local governments.

With a clearinghouse, the Federal Government may conclude that the most constructive role it can play is to provide direct support to State and local governments to continue their experiments. Certain functions may most appropriately be handled at the local level with a minimum of Federal Government involvement, supervision or funding. Indeed, the report to the Competitiveness Commission recommended that "where the Federal Government does act to promote industrial competitiveness, it should use State government wherever possible as the means for implementing its objectives." (Report at 69.)

It may well be that in many ways Federal Government instrusion will hamper the creativity and effectiveness of State and local initiatives. There is a great virtue in having 50 States experimenting with programs and we should make sure that this diversity is encouraged.

It may be that there are approaches to national problems which can only be effectively addressed by regional approaches or by coordinated efforts among several regions of the country. Sometimes it makes no sense to States to duplicate the efforts of sister States. It certainly makes no sense for the Federal Government to provide services which duplicate those already being provided by state and local government agencies.

It may be that the experience of State and local governments will give us more confidence, or less confidence, that some sort of national development bank might be effective.

Or a concensus may develop that there are new initiatives short of a development bank which are best handled directly by the Federal Government with its greater resources and national focus.

I am open to learning from the clearinghouse. Like all of my colleagues, I believe we have a crucial problem with competitiveness and want to take action to address this problem. But, I am reluctant to support untried, untested Federal programs, particularly if they impede our ability to control the budget deficit. The budget deficit is the root of much of the malaise in our economy.

Establishing a clearinghouse will help me to have confidence that the Federal Government knows what it should and can do and will avoid making the problem worse.

All of us at the Federal Government level can benefit by learning what the State and local governments are trying, to evaluate these initiatives, and to coordinate existing Federal Government resources in a way that complements these initiatives.

Priorities for the clearinghouse

While there is as yet no formal or informal clearinghouse on State and local government initiatives on competitiveness, a number of surveys have been conducted to document these initiatives. These surveys show that State and local governments are engaged in an impressive array of programs. Some of these initiatives are bold experiments and others are more traditional efforts focusing on economic development. The clearinghouse must set its priorities carefully to maximize its effectiveness.

The clearinghouse I have proposed is directed to focus on the boldest and most interesting initiatives which stimulate productivity, technology, and innovation. It is barred from involvement with those initiatives which involve economic incentives for a firm to locate or relocate facilities in that State or local community, initiatives which have no direct interest to other States (other than for those in competition for the facility). But, in between these two extremes, the center will have to evaluate the purpose and effect of an initiative to determine whether the initiative is of interest to other States and to the Federal Government.

The bill contains a description of the types of initiatives the center should focus on, but this list is not an exclusive one. The list includes initiatives which "stimulate the formation of new small businesses," "create a favorable climate for entrepreneurs," "involve cooperation among Government agencies, regional organizations, business, labor organizations, and non-profit institutions," "forster cooperation between labor and management," "generate venture capital," "organize partnerships among business and education institutions," "expedite the transfer of technology," "provide training in entrepeneurship," and encourage "the establishment of flexible, computer-integrated manufacturing systems." (Section 5A(H).) There undoubtedly are many other areas which the center should study. Indeed, the creativity of State and local governments will continually challenge the director and the center with new initiatives.

It is not always possible clearly to distinguish between these initiatives which advance the State of knowledge about how to be more competitive and those which simply provide additional economic resources to a particular firm. This will present a special challenge to the Director and the center in setting priorities. The initiatives of State and local governments range over a continuum from partnerships in basic research on the manufacturing process to special interest tax breaks to induce a firm to choose one site over another in a fierce competition among two towns in a county.

Competition among the States

We all know that States and local communities compete among themselves to entice firms to locate or relocate their plants and headquarters. In this competition, one town may offer tax incentives, it may upgrade the local infrastructure or it may lease available land at a below-market rate.

We are all aware, for example, of the competition which occurred when General Motors was shopping around for a location for its new automobile production facility, and the same has been true when Japanese automobile firms have been considering locations for U.S.-based manufacturing facilities.

Obviously, this type of competition has an impact on the economics of the firms which benefit from these incentives. Tax breaks, improved infrastructure and below-market rate leases will lower the firm's costs and that improves the firm's productivity.

But, this type of Government assistance is more like a government grant than a bold experiment. It is not directed at changing the management approach of the firm, the manufacturing process, or the employee training at the firm. It is not directed at stimulating the development of new technology or the creativity of the firm's scientists. It does not encourage basic or applied research by the firm or investments in new equipment, and, as a result, it should be of much less interest to the center.

Let me be clear. The economic development efforts of State and local governments are valuable and important. They lead to economic growth and increased employment, but in many cases the result of these efforts is more to shift the growth and employment from one city or town to another, not to stimulate a net increase in the

Nation's growth or employment. These efforts may amount to a zero sum game for the Nation's economy even though they provide valuable benefits to individual businesses.

It is not clear that the competition among the States always is healthy or fair. It is certainly difficult for a rural or economically disadvantaged community to compete with a relatively well-to-do town. Often the rich get richer and the poor get poorer in this competition. Poor States are forced to compete by offering more special tax breaks or other incentives, which they can ill afford to provide. One recent study by corporation for enterprise development found that "many Sun Belt States that cut taxes and services to attract industry are paying the price with lackluster economies . . ." ("Study finds sun belt suffers from steps to draw industry," Washington Post, March 19, 1987).

This competition among State and local jurisdictions, however, is a fixture in our market economy. States are part of that market and the Federal Government should not attempt to arbitrate this competition. It certainly has no way to prevent it. At best we can try to shift this competition to more constructive approaches, approaches which stimulate productivity of firms which already are located in the area or which stimulate the creation of new firms there and the center may help in this respect to reduce the type of competition among the state which has not proven to be constructive.

To ensure that the center does not become enbroiled in the intense competition among State and local governments, the clearinghouse I propose is specifically prohibited from assisting one State or local government in encouraging a private business to relocate any facility from one State or local jurisdiction to another or to locate any new facility in one State or local jurisdiction rather than another. (Section 5A.(I)(1)(C).) The Federal Government has no legitimate role to play in favoring one State over another when a private firm is determining whether or not to relocate or where to relocate. The center could never establish a relationship of confidence with State and local governments if it became of partisan in disputes among the States.

Similarly, the bill would bar the center from providing any financial assistance to support a State and local government to stimulate economic development through the conduct of public works or the repair or replacement of infrastructure. (Section 5A.(I)(1)(B).) Again, these activities are important functions of government and private businesses need the assistance of government on these initiatives. But, these initiatives are routine functions of government, not bold experiments of interest to the Federal Government and other State and local governments.

Similarly, the center is barred from providing direct financial assistance to fund State and local development initiatives. (Section 5A.(I)(1)(A).) Funding for these initiatives might well be available from other Federal agencies and the center may perform a service by compiling inventories on Federal funds which might be available. But, the center must not become involved in providing the funding itself or intervening as a partisan in the competition for scarce Federal resources.

Finally, the center is barred from considering any issue "included in a specific labor-management agreement without the consent and cooperation of all parties to the agreement." (Section 5A.(I)(1)(D).) This prohibition has a similar intent to those just described. The center should not serve as an arbitrator or disputes. It should provide information and monitor developments. Once it becomes a player in these disputes, it will lose credibility with any parties with an adverse economic or political interest.

State initiative of national interest

The purpose of the clearhouse is to focus on State and local initiates which provide a benefit to the Nation as a whole, which stimulate productivity for an entire industry, which develop a new technology which creates a new industry, and which lead to new discoveries about materials, products or processes. It is these initiatives which are of greatest interest to other State and local governments and to the Federal Government.

It is relatively easy for a State or local government to build a new road to service a new factory. However, State and local government initiatives which target productivity, technology and innovation require much more sophistication. These initiatives are much more difficult to fashion and they are much more controversial. The success of these initiatives is much harder to measure. Initiatives of this type are experiments. When they succeed, however, these initiatives are the ones which are the most significant in our effort to enhance the competitiveness of the Nation as a whole.

The lessons about productively which are learned by a firm in one State or city can be helpful to a firm in another State or city. One cannot pick up a new road and transfer it somewhere else, but we can easily transport an idea, a new process, or a new material from one State to another.

Under my legislation, the clearinghouse is directed to focus its efforts on those initatives which are directed at enhancing productivity, technology and innovation. It is these initiatives which are most important to the Nation as a whole and it is these initiatives which are of greatest value to the efforts of the other States. There is great value in learning about how firms increase productivity, how they develop technology and how they enhance the inventiveness of a firm's employees.

Competition for productivity

What we want to encourage is competition among the States to increase the productivity of the firms in their area, not to compete with other States in offering economic incentives to firms to relocate. When States undertake experiments in government-private partnerships, they may do so partly to compete with other States which have launched similar programs. But, this type of competition is healthy; it's precisely the type of competition we want to encourage.

Indeed, if we find that State and local governments can help to stimulate productivity of the firms already located in their area, they may find it much less necessary to entice other firms to choose their town as the location for a new facility. The center can help the States find other basis for competition than forgoing the collection of taxes or providing special and costly services that are not normally available. If States have no ways to compete other than ways that may be short-sighted, they may nonetheless feel compelled to compete.

Some argue that the State and local governments need to be saved from themselves in this competition. Proposals have been circulated that the States agree among themselves to compete in a more positive, less self-destructive way. Such an agreement might take the form of a "disarmament" treaty in which States agree, for example, not to provide special reductions in property or other taxes to entice firms to locate or relocate their facilities in a State. But, until State and local governments voluntarily limit the competition among themselves, the best we can do may be to encourage competition on the basis of constructive partnerships in enhancing productivity, technology and innovation.

Many observers have argued that States will do better in economic development if they concentrate on stimulating the establishment of small businesses rather than on attracting large firms and their subsidiaries to the State. The National Governors Association has said in a report on this issue that "most States are well aware of the limitations imposed on short-term strategies aimed at recruiting technology-based industrial firms . . . Not only are there but a finite number of firms to compete for, but also the competition itself is severe (and) no single State can hope to capture a significant number of these firms . . . in the long run . . . the key to continued economic growth and to the creation of new, more meaningful jobs for workers at all skill and age levels lies with (1) developing strategies geared to creating the right environment for technological innovation; (2) assisting inventors and entrepreneurs in new business formation; and (3) in helping existing firms to expand and prosper."

The center can help the State and local governments take positive steps on each of these points and, therein, help to reduce wasteful competition among them.

Range of State and local initiatives

The range of State and local initiatives to stimulate productivity, technology and innovation is broad and growing. With all 50 States interested in the issue, many novel programs have been launched and even more are being considered. The absence of Federal Government interest has challenged State and local governments to fill the void and they have done so with little hesitation.

There are programs where the State and local governments itself is a partner in developing a new production process, a new technology or a new invention. Some State and local governments have established laboratories, experimental manufacturing facilities or education institutions which conduct basic or applied research. Some States have established incubators which provide low-cost physical space, equipment, and technical service to start-up businesses. These initiatives are of great interest to the other States and to the federal government itself.

One of the best examples of State technology efforts can be found in Arkansas. The Arkansas Science and Technology Authority plays a leading role in Arkansas in identification, development and application of advanced technologies. It provides funding for basic research and applied research partnerships with industry, which industries in turn are eligible for State research and development tax credits. It stimulates a home-grown economy through the establishment of five business incubators which provide support to new Technology-based businesses in Arkansas. It's seed capital investment fund provides the critical initial capitalization for these new ventures. Supplementing the work of A.S.TA. is the Center for Technology Transfer at the University of Arkansas, the quality-productivity task force of the Arkansas Industrial Development Commission, and the Industrial Services Association at Southern Arkansas University all of which are working with existing industries in Arkansas to find ways to increase productivity and promote the concept of quality management.

One of the fundamental questions we have in this whole field of competitiveness is to what extent a governmental unit should itself be a partner in advancing the state of scientific and technical knowledge. We need to know more about when and how governments should conduct or organize research efforts and which research efforts have the greatest payoff to the whole community.

One of the most interesting areas for the center to explore is how States are bringing entrepreneurs and inventors into the classroom where both they and the students can interact. Universities have historically served as an important resource for the agriculture industry, conducting research on new crops and agriculture techniques and providing extension services to farmers.

Many States are establishing programs which integrate universities in the search for more productive proceses, new technology and greater economic growth. Universities no longer are the ivory towers that some have thought they should be. ("The higher education—economic development connection: emerging roles for public colleges and universities in a changing economy," American Association of Colleges and Universities and SRI International, 1986.) Georgia Institute of Technology, the University of Alabama at Tuscaloosa, George Mason University, Michigan State University and Oregon State University have been leaders in fashioning innovative university/private sector programs. Many other States are involved in similar efforts.

Another Area of activity for State and local governments is assistance to firms in marketing their products in domestic or international markets. In others, it involves providing assistance in analyzing markets, demographics or sales strategy. Many States provide management assistance to small businesses.

There are at least 10 States which are working on programs to assist small and medium sized companies in financing export sales. In California a government agency will guarantee 85 percent repayment of on loans which banks give to businesses to finance working capital or receivables related to exports. In Illinois the agency will lend banks 90 percent of the funds they use to make an export-related loan and has arranged for the Export-Import Bank to insure the State, the lender and the exporter against most losses on an export sale. There are maximum amounts to these loan guarantees or loans, $350,000 in the case of California and $500,000 in the case of Illinois. So far the California agency has made 23 loan guarantees and the Illinois agency has backed six sales. ("States launch efforts to make small firms better exporters," the Wall Street Journal, February 2, 1987.)

Venture capital initiatives

Some State and local governments have become venture capitalists, supplementing the capital markets with public funds or with investments from pension plans of public employees. There is no question that obtaining venture capital is a precondition to founding a firm. Without venture capital a firm may not be able to test a new technology, build a new production process, or conduct the research which leads to new discoveries.

In a 1984 report, the Small Business Administration found that 26 States were experimenting in offering equity financial inducements to growing companies and their investors. These efforts involve making or insuring loans issuing bonds, authorizing tax-exempt status, making guarantees, grants, equity investments and providing technical assistance. ("State activities in venture capital, early-state financing, and secondary markets," United States Small Business Administration, May 1984.)

The venture capital initiatives of State and local governments may be the most controversial of the initiatives being undertaken. There are some who will argue that there is no appropriate place for public funds to be used for this purpose. This is the argument which was raised about a National industrial development bank. Venture capitalists in the private sector have enough trouble with their investments to have confidence that the public sector will do a better job or even as well as they do. On the other hand, there are those who argue that public venture capital is needed, particularly in areas of the country which private investors might dismiss as hopelessly dependent on conventional financing and manufacturing. ("States back risky ventures in effort to create new jobs," New York Times, June 23, 1986.)

Will respect to State and local venture capital programs, the clearinghouse should focus more on how the State and local governments establish their investment strategy, what form the investments take, how the State involvement relates to that of other investors, how they supplement venture capital with other forms of assistance, and how they measure the success of the venture. The clearinghouse should focus on how these government programs compare in stimulating economic development to those of the private capital market.

Importance of small business

Many of the initiatives of State and local governments focus on Small Businesses. This focus in entirely appropriate as small businesses tend to be leaders in enhancing productivity, technology and innovation.

Employment growth in small business-dominated industries, at 5.1 percent, far outpaced that of large business dominated industries, at 0.7 percent. ("The State of Small Business," report of the President, 1986, at XIII.) Small firms generated most of the net new jobs during the economic downturns from 1979 to 1983 and they continue to be the major employer of younger and older workers, women and veterans.

It is quite clear that the small firms which thrive on venture capital investments make a major contribution to the economic growth of the country. In one study of 72 firms in which venture capitalists had invested only $209 million during the 1970's the firms had combined annual sales in 1979 of $6 billion and had created 130,000 jobs. ("Government-Industry Cooperation Can Enhance the Venture Capital Process," General Accounting Office, August 1982, Appendix II, page 9.)

Small businesses also have been found to be prolific inventors and innovators. In one study covering 635 product innovations marketed in the United States during the 1970's found that 40 percent were tracked to small firms or individual entrepreneurs. ("State of Small Business," report of the President, 1983, at 122.) Seven other studies have reached similar conclusions (Id. at 123.)

Because of the importance of small business, the center is specifically directed to collect information on initiatives, "particularly information useful to . . . small business." (Section 5A.(B)(2).) The record is clear that small businesses will, in fact, make good use of this information in their own efforts. By focusing on the needs of small business, the center can ensure that its mission to promote productivity, technology and innovation will be achieved.

Cooperation among the States

With respect to these efforts the center is directed to serve as a clearinghouse to disseminate information on how these assistance efforts are organized, which types of assistance seem most to be in need, and which agencies have developed useful data bases which could be used by other agencies. Indeed, it may be that States can share their resources with one another.

Normally a State or local government agency provides services only to the firms and residences within its jurisdiction, but there is no reason why one agency might not provide services to another agency, either as a matter of comity or under a contract. If one State develops a data base on export markets for a certain type of product, perhaps that data base could be made available to other State agencies. The center may be able to help the State and local governments to avoid duplication in developing data bases and to cooperate amount themselves in sharing information and experiences.

Evaluating State and local initiatives

One area where State and local governments may need direct financial assistance is in evaluating the initiatives they have undertaken. Typically, evaluation is the hardest and most underfunded aspect of a program.

In some cases, there may be a reluctance to evaluate a program for fear that it will be found wanting. I say this knowing that this same reluctance is common in private businesses, especially for programs where success and failure is not measured simply by a reference to profit and loss.

To be fair, however, it is very hard to determine when an initiative of a government agency has made the difference in increasing the productivity of a firm. Productivity itself is a concept that is hard to pin down. It is hard to know why some firms are more inventive than others. It is hard to say why one scientist discovers a new technology and another does not. There is controversy about how to evaluate a program just as there is in designing a program in the first place.

In addition to serving as a clearinghouse, therefore, the legislation authorizes the center to provide grants to help State and local governments evaluate their initiatives. (Section 5A.(C)(2).) These grants could be given to the local agency or to a third party, whichever is most appropriate. The legislation bars the center from providing financial assistance for the initiative itself, but it is quite appropriate for the center to provide such assistance for evaluation because only with proper evaluation can the center determine the effectiveness of the initiative.

The issues of evaluations is sure to be a sensitive one as well as an important one. State and local governments which are undertaking experimental programs have no interest whatever in the Federal Government—which has shown little willingness to undertake any initiatives on competitiveness—criticizing their efforts. If the Federal Governments chooses to be inactive on competitiveness issues, it has no right to make life more difficult for State and local governments which are taking up the slack. This is an issue of sovereignty as well as tact. But, the center will find that it cannot hope to establish a relationship of trust with State and local governments if it simply criticizes their efforts from "on high."

To ensure that the center does not trample on the prerogatives of State and local governments, the bill explicitly provides that the center may not evaluate a State or local initiative or disseminate information regarding such evaluations unless the State or local government carrying out the initiative "consents to and cooperates with such evaluation." (Section 5A.(C)(2).) This limitation will ensure that when the center does conduct an evaluation, it will be fully informed of the nature and terms of the local initiative. It cannot hope to have all the information it needs if the State and local government is unwilling to provide it. But, it needs more than access to date, it needs to discuss the initiative with the State and local government officials involved to learn from their views and their experience.

The State and local government and the center have an interest in the objectivity of the evaluation and any grant should be awarded with this need clearly in mind. There will be many vested interests involved in any initiative and it will sometimes be difficult to obtain objective evaluations, especially if the evaluation of the initiative finds that it has not achieved its purpose or matched claims of success. To better ensure that the evaluations performed under contracts funded by the center are objective, the bill includes a procedure for determining whether the organization receiving the contract has an organizational conflict of interest. This procedure has worked well with the department of energy and there is an extensive legislative history to the provision. ("Organizational conflict of interest in government contracting," hearings of the Subcommittee on Energy Research and Water Resources, Committee on Interior and Insular Affairs, United States Senate, 1975.

In addition, there is a need for the center to fund generic research in how any governmental agency can measure the effectiveness of its competitiveness initiatives. The bill I am introducing permits the center to award some grants for this purpose. (Section 5A.(F).) While the center may fund this research, it must be very careful in commissioning such research. It must be sure that the research will be helpful in actually conducting evaluations, not simply in providing interesting commentary on complex issues.

With respect to both evaluations and basic research, the center must allocate an appropriate amount from its appropriations, which are limited. In the end, the center will have less than half a million dollars for this purpose. Over time, we in Congress can adjust the authorizations and appropriations for the center as we learn how much funding is needed for these evaluations and basic research.

The interest of the center in assisting State and local governments to evaluate their initiatives is, in part, a selfish interest. The center is just as interested in the results of these evaluations as are those involved in the initiative. The center is interested in disseminating information on the most successful initiatives and in disseminating information on how each initiative compares to others and it needs as much data as it can assemble on the impact of these programs.

The center as an advisor

With its experience as a clearinghouse and with the results of its research program, the center can become a knowledgeable advisor as well as a monitor of developments. It may find that it can provide management advice to State and local governments on how they can organize successful initiatives. It may be able to approach State and local governments with suggestions on how to change a program or supplement a program with another initiative to make it more effective. The center is specifically authorized to provide advice and technical assistance to State and local government agencies under the terms of the bill. (Section 5A.(E).)

The Center can be especially helpful in bringing together State and regional efforts to accomplish a similar objective, such as establishment of a center on advanced materials. The center may be able to help State and regional organizations to avoid duplication and ensure that the limited resources which are available are not squandered and diluted by a surfeit of underfunded centers in one particular technological area. The most effective way to proceed may be to establish one center which will achieve a critical mass of resources and talent which can have an impact on the competitiveness of the United States. It may well be that the Federal Govemmment should fund such a center rather than for several State or regional organizations to fund it and the center can bring together the interested parties to make that determination.

The center may also become an advisor to other Federal Government agencies. It can keep these other agencies informed of developments which may be of interest to them, either in modifying a similar Federal Government program or in providing assistance to a State program. The center may be able to serve as a mediator between State and Federal agencies in areas of common interest or to facilitate cooperative joint efforts.

Center cannot intrude

It is vital that the center in its activities does not dominate or control the State and local governments. The purpose of the center is to monitor and assist innovative State and local initiatives. The value of this effort comes in the variety of these initiatives. If the center comes to dominate and control these initiatives, it will stifle the very creativity that gives rise to the need for the center.

This is true in evaluating the State and local government initiatives. It certainly is true in providing technical assistance and advice to the local agencies. In none of these efforts does the center have nor should it have any authority to demand that the State and local governments cooperate with it. It may not demand information from the government about the effectiveness or results of the program. It may not obtain any proprietary information on technology from any firm participating in a program.

Similarly, the center may not direct another Federal Government agency to take any action or modify any program. It may "study ways in which Federal agencies can use existing policies and programs to assist State and local governments in carrying out (their) initiatives," it may "make periodic recommendations to the Assistant Secretary (for Productivity, Technology and Innovation) concerning modifications in such policies and programs," and it may "convene meetings and conferences of Federal, State and local officials in order to carry out joint and cooperative initiatives" but in none of these efforts does the center have any authority over other Federal Government agencies. (Section 5A.(D) (1), (2) and (3).)

The center must "establish relationships with State and local governments" before it can serve as a partner and a resource. (Section 5A.(B)(1).) These relationships must be based on trust and they must be voluntary. The credibility and usefulness of the center, and it access to information and data, will depend on the value of the assistance it can provide and the sensitivity it has to the autonomy of State and local governments.

The power of the center is inforamtion. Its ability to award grants is not so great that this alone will persuade State and local governments and other Federal agencies to cooperate.

I am confident that the center can establish a strong working relationship with State and local governments and other Federal agencies. The reason why State and local governments take the initiative to stimulate productivity, technology and innovation is that they are public spirited. I am sure that they will be delighted to work cooperatively with the new center and to assist other agencies to accomplish the same objectives as they seek to accomplish. The same is true of other Federal Government agencies.

Indeed, we are all affected by the decline in the competitiveness of our country. We need to work together on the problem. If our efforts degenerate into a competition for what remains of a shrinking economy, we all are sure to suffer even more. This is why we need a clearinghouse to bring us together, to learn from one another, and to cooperate for our common good.

Miscellaneous provisions

The center is authorized to enter into contracts itself, or jointly with other Federal agencies, "with public and nonprofit private entities" in performing its functions as a clearinghouse, evaluator and technical advisor. (Section 5A.(K)(2)(B).) It is also authorized to enter into contracts for evaluation which are partly or wholly funded by "another Federal agency, a State or local government, or a public or nonprofit private entity." (Section 5A.(C)(3).) The center has the flexibility it needs to perform its functions.

The center might find, for example, that existing State or regional organizations have compiled useful lists and descriptions of State and local initiatives and it might provide some contract funds to these organizations to continue and expand their efforts. It might find that a regional body could organize an importance conference on an important issue. Or it might find that a nonprofit agency could provide technical assistance to a number of State governments.

The center is directed to issue an annual report to be transmitted to the Congress on its activities. (Section 5A.(G).) The report is required to include a description of the initiatives of State and local governments, summaries of any evaluations of these initiatives undertaken by the center, descriptions of any basic research undertaken by the center, and the recommendations of the center on ways Federal agencies can be more helpful to State and local governments in enhancing the competitiveness of U.S. business.

The Director of the Center is authorized to establish an advisory board to assist it in its activities. The Director shall appoint a "broad range of members" to the board "including officers of State and local governments, leaders in businesses and labor, and experts on productivity, technology and innovation." (Section 5A (L).) The advisory board has some independence from the center and it can "make recommendations to the Assistant Secretary, the Director, and the Congress concerning ways in which Federal agencies (including the center itself) can use existing policies and programs to assist State and local governments" with their initiatives. The advisory board should offer frank and constructive advice to the Assistant Secretary and the Director and it can serve as a vital bridge between the center and State and local governments. It is vital that the board enjoy the confidence both of the Assistant Secretary, the Director and the Congress, but also of the State and local government agencies.

The center is directed to work closely with other Federal agencies interested in enhancing the competitiveness of U.S. business, including the Departments of Agriculture, Defense, and Labor, the National Science Foundation, and the Small Business Administration. (Section 5A (K) (2) (A).) The center is specifically directed to work closely with Federal, State and locel agencies "responsible for enhancing export opportunities for United States businesses." (Section 5A(K) (2)()(C).)

The center in S. 930 is authorized $2 million for fiscal 1988, $3 milion in fiscal 1989 and $4 million in 1990 and thereafter. This is a modest sum and perhaps it provides too little in resources to the center. This authorization includes funds which would be used by the center for grants and contracts for evaluations and generic research. Because of the limits on funds for the center, initially it should focus its efforts on its responsibilities as a clearinghouse rather than on evaluations and generic research. It is the responsibility of the director, however, to determine how much of the funds available to the center shall be allocated to the clearinghouse, evaluation, and generic research functions.

Commerce Department and OPTI

In my bill, the new center is to be located in the Office of Productivity, Technology and Innovation (OPTI) in the Department of Commerce. OPTI is an agency that I have long supported and on several occasions I have made sure that the administration's efforts to slash its budget have not been successful. Indeed, at one point the administration argued that OPTI should be abolished because its mission had been "completed." In fact, OPTI is a bright light in this administration as an agency which is trying to make government work, not simply to avoid dealing with real problems.

To a very limited extent, the functions of the center are performed already by the OPTI. Because OPTI does monitor developments at the State and local level and serve to a limited extent as a clearinghouse, the bill places the center within OPTI. By establishing the center by statute, however, we can give it visibility, ensure it has enough resources and lend it the credibility of the Congress.

I also believe it is important the center be located in the executive branch, not as an independent body. Under the bill the Director of the Center is appointed by the Secretary of Commerce and reports to the Secretary "through the Assistant Secretary" for Productivity, Technology and Innovation. This means that the Director will be a part of the administration, not independent of it.

There is some risk in this, especially if the center is part of an administration like the current one which opposes nearly all forms of constructive partnerships between the public and private sector and between the Federal and state governments. But, to be effective—particularly in its role in recommending modifications of current

Federal Government policies and programs—the center needs to be accountable to and a part of the administration. It needs to have political clout in order to help State and local government agencies in dealing with the Federal Government. It needs to speak for the administration when it is called by the Congress to make recommendations or to evaluate proposed policies.

The center belongs in OPTI and its existence will enhance everything that OPTI already does to stimulate the competitiveness of the country. OPTI is one the only current Federal agencies which can understand and appreciate the initiatives of State and local governments.

The challenge we face

It may be said that S. 930 is not dramatic enough or massive enough. Some would argue that we need to spend huge new sums on some programs on competitiveness. Others would argue that we need to erect barriers to the imports which are flooding our markets. But I think the competitiveness problem is more complex than that and that we need to undertake many different initiatives to have an impact.

We cannot pursue any single strategy. Our economy and the world economy are too complex for any level of government—Federal, State or local—to have a major impact on the competitiveness of the private sector. The resources of government can help but the private sector has many times the resources available to it.

Indeed, in many ways government cannot affect the competitiveness of private business. The competitiveness of a firm depends in large part to the foresight of its management and the creativity of its technical people. These are qualities that cannot be legislated.

But, the government may be able to serve as a partner. The State or local government may be a more sensitive and more constructive partner than can be the Federal Government. The Government can provide some leadership. It can incourage risk taking and it can provide information.

What this proposal says is that we need a decentralized strategy which draws on the creativity and innovation of many sectors, public and private, nonprofit and commercial, education and training.

By pursuing a broad-based and multi-faceted strategy, we are more likely to enjoy success. Vast new Federal programs have a potential for doing harm as well as good, especially if they impede our efforts to control the budget deficit.

Given the constraints on funding any new Federal Government programs, the Federal Government can start by working constructively with State and local agencies which are taking the lead in stimulating productivity, technology and innovation. It can at least help us all to learn about the complex challenge we face from international competition.

I view S. 930 as non-partisan and non-controversial. The authorization for the new center is modest, only $2 million the first year, $3 million the second and $4 million thereafter. The center's powers are limited and it is prohibited from becoming involved in the on-going competition among the State and local governments on economic development. The center will enhance the effectiveness of State and local governments and it will help the Federal Government to chart its own competitiveness programs.

We can all benefit from the initiatives of State and local governments if we share information about their successes and failures. The clearinghouse can bring us together with information, which can help to bring us together for action.

The center speaks of risk taking, partnerships, and long-term efforts. It is not a panacea. It does not over-promise. It does not underestimate the complexities of the challenge. It's a modest proposal but therein lies it virtue. It will help, it is constructive, it is pragmatic and it is something we can come together to do now while we debate grander and more controversial proposals.

A copy of the bill follows.

The CHAIRMAN. Our next witness is the Honorable Clarence J. Brown, Deputy Secretary of Commerce. Secretary Brown, we welcome you to the committee. From your own experiences you well know we are delighted to include your statement in its entirety in the record, and you can highlight it or deliver it in full as you wish.

STATEMENT OF CLARENCE J. BROWN, DEPUTY SECRETARY, DEPARTMENT OF COMMERCE

Mr. BROWN. Mr. Chairman I have a somewhat briefer statement to give you orally and would ask that my full statement be inserted in the record at this point.

With me today is Dr. Helmut Hellwig, who is the Associate Director for NBS, whose disciplines are Physics and Electrical Engineering, and Mr. Jack Williams, Director of the Office of Productivity, Technology and Innovation of the Economic Affairs which is part of the Commerce Department.

Mr. Chairman, I thank you for the opportunity to testify before you this afternoon. With your permission I will summarize the statement as I said, and ask that the full version be made part of the record.

S. 907, the Technology Competitiveness Act of 1987, asks some good fundamental questions about how well equipped we will be to compete in a world of rapid technological change. How well we will do in the race to transfer new discoveries from the laboratory to the marketplace, and what the Federal Government can and should do about these problems.

It addresses these issues by formally giving NBS the new mission of conducting the necessary generic research for developing new basic technology and changing its name to the National Institute of Technology; by authorizing some $27.4 million more than the President has requested for its basic programs; by combining NBS with OPTI, NTIS, the National Technical Information Service, and the Japanese technical literature program into a new Productivity and Technology Administration; and by creating $130 million worth of new programs to establish regional centers for transferring manufacturing technology developed by the Institute to the private sector, to purchase flexible manufacturing systems to be leased back to small manufacturing firms, and to establish a fund to help small business and joint research ventures commercialize new scientific discoveries.

I do not think there is any question but that advanced computer driven manufacturing technology will be essential if American industry is to meet the competitive challenge of the next century. It gives manufacturers increased flexibility in changing product design and responding to market uncertainties.

It would be a mistake to think that it is the answer to all of our problems, or that other technological developments deserve less attention.

Super conductivity comes readily to mind. In the past 60 days the private sector has announced striking technological breakthroughs in super conductivity which will affect every aspect of our lives, including how we manufacture the products we use and sell. It will open up possibilities that were dismissed as fanciful just a short time ago.

Other new technological breakthroughs may only be an experiment away. In 1968, Mr. Chairman, as a country newspaper publisher I had the responsibility of converting our family business from letter press to offset. I must tell you that that took an awful lot of struggle and thought on our part and it took a great deal of money. It also had some drawbacks to it at the time, but it proved ultimately to be a great advantage.

There are some fundamental problems from that experience that I can tell you affect the ability of business to adapt to new technologies and they are not necessarily problems that the government can always solve.

The cost of that kind of change in a small business or even in a large business, is substantial. The automobile industry has recently been through some of that. Justification for the change and the time it takes are just some of those fundamental problems.

New technology, such as flexible manufacturing or super conductivity, may provide lower unit costs, but they are expensive in their initial investment. They require high initial outlays. The cost of scrapping existing operable, if suddenly inefficient, equipment is often difficult for managers to justify. Then there are the costs of training workers, reorganizing management, and the lengthy installations periods when there is little or no production.

Accordingly, willingness to make these experiments will depend on many things—long term confidence in the economy; the cost of capital; exchange rates; interest rates and inflation rates. All these things will affect both the supply and the demand for new technologies. To a very large extent, it will depend on whether managers have the right analytical tools for making the necessary assessments.

Most observers tell us that justifying the expense of radical changes in technology and determining payback periods using traditional accounting methods is a very difficult proposition. It is very hard, for example, to quantify the benefits of flexibility itself when one is thinking about putting in a new flexible manufacturing system.

Fortunately the private sector is doing something about this. The Big Eight accounting firms and the National Association of Accountants are working to develop nationally accepted cost accounting standards for various forms of factory automation. It should do much to hasten the adoption of new manufacturing technologies by firms of all sizes.

Government too has a role to play. Smaller companies need to be able to buy automated machines and systems in stages, a few at a time and build up to an integrated system. They need the flexibility to buy from different vendors at different times with the assurance that what they buy will work together.

The Corporation for Open Systems in Computers, stimulated by the Institute for Computer Science and Technology at the National Bureau of Standards, in response to private manufacturers complaining about computer incompatability made the first steps to cure the problem of computers that do not talk to each other.

That is just what NBS's automated manufacturing research facility is trying to do also. Through a combination of direct appropriations and R & D performed for other agencies, most notably the Department of Defense on a reimbursable basis, some $12.5 million is now being spent on automated manufacturing research facility research.

Ultimately NBS hopes to show that it is possible to put together a manufacturing facility the way you put together a home stereo: from readily available components of different kinds.

What all this tells us is the introduction of advanced technology will be pulled by demand, that the demand will grow more quickly as the costs are reduced through standardization. Also, that as businesses develop the necessary tools to justify making the necessary expenditures, and that as we solve these problems, we should be in a better position to decide whether the government can make additional contributions, and if so, what they might be.

One contribution we should not make is to take over the private sector's responsibility for performing applied research. The administration continues to believe that the government should continue to channel its efforts into basic research.

I particularly disagree with the idea that we can improve the way we commercialize what we discover by establishing a $40 million fund to provide small business and joint research ventures with seed money to commercialize new scientific discoveries of economic value. The theme of that seems to be that we are hampered only by lack of capital and a lack of ability. Neither is the case.

As to capital I should like to remind the Committee that only two and a half years ago the Joint Economic Committee of the House and Senate released a major study on venture capital and innovation, which concluded that the investment of venture capital is heavily skewed toward entrepreneurial firms that are trying to bring a new technology to the market, improve existing technologies or apply technologies to creating new products and processes.

The study went on to say that the best things that government could do would be to pursue the kind of sound fiscal and monetary policies that promote a favorable climate for investment and to resist the temptation to interfere with and distort the marketplace.

As to the second perceived problem, I disagree with those who say we are not smart enough to commercialize what we invent. However I do think we have not always been wise about the way we have managed what we have invented. The private sector and the public sector have each made some mistakes.

For too long, the private sector, in an effort to expand into new markets entered into various business alliances with foreign firms such as joint ventures, licensing agreement and marketing, manufacturing or supply arrangements under which these private venturers gave away precious technology in such fields as consumer electronics. They literally gave the stuff away.

Many of these firms are either shunning such giveaway arrangements today or demanding technology of equal value in return. That is very encouraging. It is an illustration of the old Pennsylvania Dutch homily, too soon old, too late smart.

The Federal Government also made some mistakes. For too long it made it hard for a firm to obtain exclusive rights to inventions resulting from federally financed research. Companies saw non-exclusive arrangements as far too risky and thousands of government patents languished on the shelf. Some still languish.

Contractors had little incentive to try to develop practical uses for their research discoveries. The President's recent Executive Order addressed this by affirming the basic principle of contractor ownership of federally financed inventions, and by calling for prompt implementation of the Technology Transfer Act, which gives generous incentives to federal employee inventors. It also encourages federal labs to enter into cooperative R & D agreements with business, schools and state and local governments, and to sell the exclusive rights to resulting inventions.

It also called for greater attention to be paid to the policies of other countries before we let them participate in these arrangements. It called for several agencies to establish programs for sharing their technologies with U.S. industries and universities, and directed agency heads to consider establishing basic science and technology centers at universities in addition to those new ones to be funded by the National Science Foundation.

Having said that much of our problem is a management one, the administration agrees that it is appropriate to explore some new organizational arrangements. A lot can be said for housing NBS, OPTI, NTIS and the Japanese technical literature program under a single roof. NBS, for example, has agreed to house the Federal Laboratory Consortium and should be able to work very closely with OPTI in identifying private sector needs and developing policies for transferring federally financed technology to it.

NTIS has many years of experience in identifying private sector needs for technical information, and in licensing federally owned patents. But we do not agree that a new Under Secretary is appropriate. We already have four and may soon get a fifth in the Department of Commerce, the smallest Department of the Federal Government. A sixth would be too much we think. If we are not careful there will not be room in our parking lot for anyone below the level of Under Secretary.

We propose instead that the position of Assistant Secretary for OPTI be dropped and OPTI report to and be made part of NBS where it will report to the director, an official who already has the status of an Assistant Secretary.

In short Mr. Chairman, if there is to be new funding, it should go to those programs that will do the most good, such as the cold neutron facility for which the President has proposed $6.5 million, and for which we are getting a lot of calls today because of the developments in super conductivity. Industry would like to know when it can use that facility to test the ceramic products that will be necessary to make super conductivity a reality.

Whatever direction S. 907 takes, we must avoid repeating what happened in previous years when cuts had to be made in import and export administration in the Commerce Department, or in the 1990 Decennial Census which will develop all of the retail market statistics and demographic statistics for the next decade.

Those expenditures were cut back and now we are running very hard to catch up for the Decennial Census of 1990. Those were both cut to fund last minute add-ons in the Department. There is simply no room for trade offs at this point, in the Department of Commerce, Mr. Chairman.

Thank you, Mr. Chairman.

Mr. **Brown**. I will be happy to try and respond to questions.

The **Chairman**. Thank you very much Mr. Secretary. With reference to the reference you made that the government should resist the temptation to distort the market place, Mr. Secretary you and I are not in charge. We can not distort it. It has already been distorted. What we are trying to do in the real world is play a little catch up ball and respond to the distorted market.

On one hand they have the socialist or communist system of a billion Chinese ready to work for 18 cents an hour, and the international markets moving very fast. You might not have seen it in your printing business, but we saw it in our textile business long ago.

Other governments of that kind and others, particularly the Japanese, who have distorted the market place by paying for the research and financing the banks. It is a crime in the United States for the bank to own a manufacturing entity. 43 percent of all manufacturing in Japan is owned by banks. And they are coming into America and making sweetheart loans to not only industries, but to the state of Michigan and many other organizations of that kind for the financing.

So even though we have a law and we have antitrust, they don't. You can go right down the line. When they put a product into the domestic market it is controlled there, and when they finally bring it into the international market, it is on a targeted or dumped basis.

So that is the market I am trying to respond to. Now we can continue moaning and groaning and tell them to save less and consume more, but I never heard of such a silly approach in my life. If a Japanese official came over into my office and asked me to get the American people to save less and spend more, we would probably run him out of the office. That is not working and will not work.

I am not bashing Japan, I admire their success. They have come from the vanquished to become the victor. And in 40 years they have achieved a per capita income of $18,000; you and I only have $17,700. So what they did has worked, has succeeded. I used to talk about how of the five largest banks three were Japanese. Now it is six out of six. They have 25 percent of financial holdings. That is the market.

So we sit here with blinders on that we are in charge and we have the market, and what might happen with this little bill designed to distort it. The intent of this bill is that at best we might catch up and get into the swim and be able to survive. In reality, you do not have to worry about distorting the market, it is distorted. And there is not going to be change with political implorements about saving less and spending more, and flagellating over $300 million Japan sells here when we have only a $120 billion share of the Japanese market.

They react the administration for Silicon Valley, but not for Horse Creek Valley.

So we know from our hard experience in the market place that is fairly well fixed. It is dynamic, and the Europeans have followed on. What we must do as best we can is try to get on this fast track. It is not a lack of capital to do the research. It is a lack of many, many other things.

I have worked with the Bureau of Standards. I saw General Electric come in one day ten years ago, the government had asked for bids for housing at Vandenburg and they won. At that time it was $17,000 for a three bedroom home, two and a half baths. They had all kinds of special roofing, they did not have the copper piping, but they had the fiberglass and everything else of that kind.

We worked through the Bureau, we tried to break down all the local zoning laws so that it could be marketed. In the end I can see Mr. Otto Klimmer walking right through the office with a big old briefcase headed to Tokyo because he was going there to sell the technology. He made a deal, and they developed that technology. It was not that he was not smart enough, he knew how to do it, he just could not get any American company interested.

So all the houses built in Bahrain and downtown Saudi Arabia are built with American technology by Japanese workers for Japanese profits. And that is what we have been seeing in all my experience of 20 years up here. It is not that the Japanese are not smart enough, rather we put in a bill because we do not think we are smart enough.

I do not think the politicians in Washington are the ones who are not smart enough to recognize the facts of life. We hope we can see some semblance of cooperation here. You are talking about money, we are willing to pay for it. I will give you a list of revenues. I have eight votes in the budget committee for a $10 a barrel import fee, and then for further funds, a Value Added Tax.

We will get these revenues. I do not know that we can get it under this administration, but we need that kind of money to get rid of the deficit and get rid of the debt and get the government and people moving in this country.

So I am not worried about the money. Gramm-Rudman-Hollings calls for revenues. It just says whatever budgets you pay, have truth in budgeting. You can give it all to the Pentagon and eliminate the domestic side, as long as you pay for it there is no trigger. Or you can give it all to food stamps and eliminate the Defense Department, as long as there is no trigger.

So Gramm-Rudman-Hollings is not causing all of these things, we just said just tell the truth. That is all. If you do not tell the truth then just cut right across the board. Those are the triggers that are coming into being and I see it with the cities and the EDA. They are doing away with those programs. We are increasing funding for SDI and sending the bill to the mayor.

We have done away with revenue sharing, we do away with EDA we do away with other kinds of programs, such as feeding, housing and everything else. They are on the grates, and we say let the market function. So you folks have got to change your attitude the market is entirely different out there. Our government is not responding to the market. We have moved in a similar fashion to help industry to where agriculture was on account of the international forces.

We tried and we will continue to try to maintain that free market. But like Roosevelt and the days of the Depression, keep the banks open, close the doors. We in turn are going to have to raise some barriers to remove them both, and in the meantime get our government to get these things commercialized. It pays to leave and commercialize them, then take those profits and get more research. Yes, in 1987 we are ahead in research, by 1997 we are going to be behind in research. We are going the way of England.

I appreciate you listening to me. I apologize, but you can see the questions that I will go through and to be picky, picky, picky. I know you will stand by your statements. But the statement does not hold true when it talks about money and the market, and how we develop programs government's to answer our problems. This is a modest, very, very modest endeavor to take something good, and you have an excellent Bureau of Standards, and really get it out of the back room and out into the front in participating in our society.

They have more technology backed up there, it is an amazing thing to me. We do not do anything about it. We just sit on it.

Mr. BROWN. I would suggest that the AMRF program, Mr. Chairman, and also the work done in the Corporation for Open Systems are both an indication that we have done something more than leave it in the back room.

I would also like to point out that the expenditures of the National Bureau of Standards, about half come from direct Congressional appropriations.

For the rest, the Bureau of Standards has gone out and hustled in the government community and in the private sector. And there is some merit in that. We do not want it to become entirely a job shop, but in fact the Bureau of Standards has gotten support from the private sector and other elements of government because that keeps them responsive to the things that other agencies and the private sector are interested in.

I guess our only real difference here is that I am not sure that there are people smart enough in the Federal Government to select the winners and losers.

The CHAIRMAN. We are selecting technology that comes along.

Be that as it may. Senator Rockefeller?

Senator ROCKEFELLER. Yes, thank you, Mr. Chairman.

Bud, following a little bit on what the Chairman said, I am an enormous advocate of the Bureau of Standards, for a lot of reasons which I have described, and a lot more which I will describe in the months and years to come.

But part of this business of commitment comes down to funding. And they have been on a flat curve, or a flat line, for a long time. About $120 million for a long period of time; about $122 million in fiscal 1987.

Now, they have some increase this year. But on the other hand, Senator Hollings legislation would call for some specified substantial increases, $44 million or so.

The National Science Foundation, which is also extremely important and very interesting, got doubled by the President this year.

Now if you go to the National Bureau of Standards which was founded by McKinley in 1901, the whole purpose of the place is to take an invention and turn it into manufactured processing. That is what is carved into the marble in the front hall.

Which strikes me as the largest problem we have, as described by Chairman Hollings, in our society today; at least in our American society.

I wondered, well, one, it is a little bit late for the question, but I wondered why not bring NBS up together with the National Science Foundation? I agree it is obscure. But it is incredible in what it is doing.

And I have discovered there are not that many people that go out there to visit; that is not that many politicians go out there to visit. Maybe because it is called the National Bureau of Standards, which is also cured by Chairman Hollings legislation.

But why the flat funding all these years? And why not do with it financially what is being done with the National Science Foundation? And why resist more money, if you are, that comes through the Hollings amendment here?

Mr. Brown. Well, first, let me submit for the record, if I may, the history of the funding of the National Bureau of Standards since about 1974, when the Presidential proposal was $60.751 million, and the Congress appropropriated $59.751 million.

And I think if you look at that list, our proposal for the current fiscal year, that is 1988, the budget that is under consideration now, is $138.625 million.

[The following information was subsequently received for the record:]

DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
Research and Technical Services (thru 1987)
Scientific and Technical Research and Services Appropriations
Historical Summary

Submission

	Presidential	Appropriation
FY 1954	7,617,000	6,000,000
FY 1955	8,000,000	6,250,000
FY 1956	8,163,500	7,413,500
FY 1957	9,000,000	8,750,000
FY 1958	11,798,094	9,726,344
FY 1959	12,823,000	12,454,900
FY 1960	17,500,000	17,250,000
FY 1961	20,553,000	19,753,000
FY 1962	28,950,000	23,500,000
FY 1963	30,700,000	28,165,000
FY 1964	33,250,000	28,700,000
FY 1965	35,843,000	30,843,000
FY 1966	29,982,000	27,417,000 1/
FY 1967	31,452,000	29,917,000
FY 1968	38,077,000	31,375,000
FY 1969	37,635,000	34,995,000
FY 1970	39,608,000	38,887,700 2/
FY 1971	45,745,000	43,524,000 3/
FY 1972	46,937,000 4/	46,665,000 5/
FY 1973	74,504,000	55,985,000 6/

1/ Reflects a comparative transfer to the Environmental Sciences Administration of $5,543,000 and excludes NTIS.

2/ Includes 1970 pay increase supplemental #1 request ($2,187,000) and 1970 supplemental #2 ($845,700).

3/ Reflects comparative transfer to "Research, Engineering, Analysis and Technical Services, "Office of Telecommunications, DoC ($61,000), and includes pay raise.

4/ Includes 1971 pay increase supplemental of $2,760 000.

5/ Includes 1972 pay increase supplemental of $1,040,000.

6/ In FY 1973 $69,359,000 was appropriated, including an increase of $10,812,000 for ETIP. OMB deferred $5,612,000 for eventual use through FY 1977 and rescinded $7,762,000 appropriated for expansion programs.

NBS Historical Budget Summary

FY 1974	60,751,000	59,751,000 7/
FY 1975	65,036,000	60,634,000 8/
FY 1976	62,455,000	61,691,000 9/
FY 1977	68,905,000	68,905,000 10/
FY 1978	74,812,000	74,785,000 11/
FY 1979	99,074,000	89,129,000 12/
FY 1980	99,115,000	95,209,000 13/
FY 1981	102,869,000 14/	104,095,000 15/
FY 1982	126,606,000	120,278,000 16/
FY 1983	104,362,000	120,591,000 17/
FY 1984	98,700,000	120,618,000 18/
FY 1985	126,062,000	123,485,000 19/
FY 1986	120,001,000	123,985,000
FY 1987	123,953,000	122,000,000
FY 1988	138,625,000	

7/ Includes pay increase supplemental of $3,002,000.

8/ Includes pay increase supplemental of $1,480,000 and appliance labeling and efficiency supplemental of $1,000,000 (appropriation level only).

9/ Includes pay increase supplemental of $1,667,000.

10/ Includes pay increase supplemental of $2,700,000.

11/ Includes pay increase supplemental of $3,632,000 and refined oil supplemental of $900,000.

12/ Includes pay increase supplemental of $2,585,000.

13/ Includes pay increase supplemental of $2,626,000.

14/ This is amended Congressional request. Original request was $107,869,000. Reduction of $5M was for basic research.

15/ Includes pay increase supplemental of $2,850,000 and rescission amount of -$1,188,000.

16/ Continuing resolution level.

17/ Continuing resolution of September 30, 1983 reflecting an increase of $1,649,000 for Robotics. Includes pay increase supplemental of $2,730,000.

18/ Includes program supplemental of $2,900,000 for computer and $2,000,000 for telephones. Original appropriation was $115,718.

19/ Of this amount $1,019 is proposed for rescission and $201 for deferral. Rescission enacted at $500K.

NOTE: Plant and facilities appropriation merged with STRS appropriation in FY 1974.

Senator ROCKEFELLER. But only three of that is for an increase in programming.

Mr. BROWN. I think that is not correct. Let me look at the effort. Some of it is increased program. Some of it is for the cold neutron reactor.

Let me find my budget figures here.

Senator ROCKEFELLER. I guess my point is that there is this interesting series in the Washington Post about superconductivity. It is very interesting to me, Mr. Chairman, that 20 of those CEOs around the country that look at these things are saying, well, this is all terrific, but we are not going to be able to compete with the Japanese.

We are at the threshhold of these incredible discoveries, but we are not going to be able to use it. In the article this morning a Mr. Home, who is an innovator and a discoverer, is more pessimistic than that—kind of wonders what it is all about.

And it just draws to me the importance of a place like the National Bureau of Standards or efforts like it wherein invention is turned into productivity and process on the factory floor.

And I only see $3 million in new programs for NBS for this coming year, and I recognize it is too late for the President to change his budget. But it is not too late for the Hollings amendment to be accepted, and to increase their mandate.

Mr. BROWN. Mr. Chairman, I am going to have to submit for you the current budget figures. I thought I had them here, but I do not seem to be able to turn to them, and what I am given is not——

Senator ROCKEFELLER. You have—there is a total new proposed program changes of $2,928,000.

Mr. BROWN. Our budget this year is an increase over last year of about $14 million.

Senator ROCKEFELLER. That is correct, of which—well, we will not go over that again.

[The following information was subsequently received for the record:]

SUMMARY OF FY 1988 NBS BUDGET REQUEST

Budget Page		Budget Subactivity	Budget Authority ($K)	STRS Staffing Perm. Pos.	STRS Staffing FTE
	FY 1987 Appropriation..................		$122,000	1,605	1,733
	FY 1988 Proposed Changes:				
	Adjustments to Base and Built-in Changes:				
NBS-11	1987 pay increase & related costs	Various	+1,780	...	...
NBS-11	1987 Federal Employees' Retirement System	Various	+4,661	...	...
NBS-11	Other Increases	Various	+7,601 1/	+8	+25
NBS-11	Other Decreases	Various	-345	-35	-39
	Subtotal		+13,697	-27	-14
	Program Increases:				
NBS-21	Process Control & Qual. Assurance	Meas. Res. and Stds.	+3,550	+36	+27
NBS-23	Computerized Reference Data	Meas. Res. and Stds.	+500	+9	+6
NBS-29	High Performance Composites	Matls. Science and Eng.	+1,500	+12	+6
NBS-36	Lightwave Meas. Technology	Eng. Meas. and Stds.	+500	+6	+3
NBS-38	Bioprocess Engineering	Eng. Meas. and Stds.	+750	+8	+4
	Subtotal		+6,800	+71	+46
	Program Decreases:				
NBS-41	Fire and Building Safety Research	Eng Meas. and Stds.	-3,872	-49	-53
	Total, Proposed Program Changes		+2,928	+22	-7
	Net, All Changes		+16,625	-5	-21
	FY 1988 Request		138,625	1,600	1,712

1/ Major components include:

Asbestos and PCB Safety Modifications to NBS Facilities		$2,880
Cold Neutron Research Facility		2,000
Equipment depreciation		1,140
Other Cost of Living Increases		1,581
	Total	7,601

Mr. **Brown**. Beg your pardon, it's over $16 million above what we spent last year, about $14.5 million, $14.7 million over the request that we made the previous year.

In that program, there are increases in several of the specific disciplines that are under study at the Bureau. The figures that I have are, ceramics, about $1.5 million; biotechnology, about three-fourths of a million; light wave metrology, $500 million; computational data, $500 million.

And we are going to spend also, the Congress willing, $2 million for the cold neutron reactor, which will give us a lot of capacity once it is completed.

It has been delayed now a couple of years, not by a failure to request it, but by the failure of the Congress to appropriate the funds for it.

The opportunity to get into the field of ceramics, and into a lot of surfaces technology that will have application in composites and other industries, other new technological areas.

Senator **Rockefeller**. I agree with you. The cold neutron thing is going to be enormously effective, not only for that, but for—for what you mentioned—but for steel and for a lot of other——

Mr. **Brown**. It will be. And it has been requested now for three years in a row. And last year is the first year we had any headway.

Senator **Rockefeller**. Well, you and I disagree on figures. I still put to you the fundamental philosophical question of the National Science Foundation with the catchy name gets double—got double the budget. And I am all for it. It is Tremendously important; it has been an excellent step by the President.

But what we are suggesting here is that the National Bureau of Standards, or the National Bureau of Technology, attacks the fundamental national problem. We are not short of discoveries; we are short of process.

And that is where so much of it can be done. Perhaps we could have a colloquy on this through letters in more detail.

Mr. **Brown**. Well, I think the distinction ought to be drawn is that the work of the National Bureau of Standards, historically, has not been to be in the basic research areas that the National Science Foundation undertakes.

The work of the National Bureau of Standards has been to do research in the setting of standards for other scientists to build on, including those in the National Science Foundation as well as those in the private sector, and other parts of the Federal Government, where an immense amount of basic research is being done, some of it in my old congressional district at Wright Paterson Air Force base by the Defense Department.

Some of that never sees the light of day, unfortunately. Those standards for that kind of research are what the National Bureau of Standards does.

We do not have the assignment, historically, to get into the area of pure research for the fun of the research.

Senator **Rockefeller**. Mr. Secretary, I totally understand that. I understand it is a different kind of transitional research——

Mr. **Brown**. Well, for that reason—if I may go ahead—for that reason, then, what we are doing is not a lot of research in superconductivity. Somebody else is doing that research.

But when it comes to the standard by which the work in superconductivity is done, we are the ones who get into that kind of research.

Senator **Rockefeller**. Right. And that is why I am not talking about research. I am asking you about budget. The thrust of my question was budget. How much research they do is one thing.

Budget is how much is recommended and how much they get. I am saying, they are not getting very much.

Mr. **Brown**. Well, considering what we spend——

Senator **Rockefeller**. I might say something else. You indicated Wright Patterson Air Force base. It would be my instinct—you are quite correct when you say that somewhat less than half their budget comes from the government, that is, from the appropriation process directly.

A lot of it comes from private sources, and a lot of it comes from other government agencies, one of which is defense. But I am not entirely convinced if they had their way out there that they would do—I think they have to depend on Defense some, but I am not sure they feel they get the return in terms of the purpose of the National Bureau of Standards for their Defense dollars.

I am not sure they would choose that way if they really had their free choice on the matter. Do you read what I am saying?

Mr. **Brown**. I have lost who the "they" is.

Senator **Rockefeller**. Well, they being the National Bureau of Standards. They do get money from the Department of Defense. I am not entirely convinced that they would pursue that money if they had more money from us that they could pursue for their real purpose, which is shifting invention in floor and manufacturing process.

Mr. **Brown**. As I said, I think we can go too far in making the Bureau of Standards into a job shop, but there is certainly merit in having a live contact. Money is the blood of that relationship with the private sector and with the public sector when it comes to getting into the studying of standards that are appropriate to the kind of research.

As you know, it is not our only relationship with the private sector. This year we will have some 200 associates at the Bureau of Standards from private companies around the country who donate literally a year of time to be brought up to date on what the Bureau of Standards is doing.

And the synergism of that is that we benefit from—that is, we in the Bureau of Standards benefit from the people from the private sector coming in and telling us what is going on, if you will, out there.

The point I would make to you is that through presidential request for budget, we have moved in the 15 years from 1974 to 1988, from $61 million to almost $139 million.

We have had not every year the support of the Congress in that increase; and some years the Congress has given us more.

So I do not think it can be ascribed to the administration, whether we are talking about a Republican or a Democratic administration, nor necessarily to the Congress, that the Bureau of Standards budget has not increased a little faster.

On the other hand, it has continued to increase by the work we have done in going out and getting our own funds to get some of this work done.

Senator **Rockefeller**. And I understand that. I would like to bring this line of questioning to a close, because we appear to be talking in two different directions.

In 1982, the budget was $120 million; in 1988—1987, fiscal 1987, the budget was $122 million.

That is not what you would call a dramatic curve?

Mr. **Brown**. No, it is not. But in 1982, the administration asked for $126.6, and got from the Congress $120.278. So we do get differences of opinion about this.

Senator **Rockefeller**. We will get to that at another time, Mr. Secretary.

I would like to ask you another question if I might. You are aware, I think, that Congressman Boland and Congressman McKay are looking at a bill that would establish an office of extension services within the National Bureau of Standards, or you may be aware of that; I am not sure.

And this office of extension services would assist state programs that work directly with companies to promote the use of state-of-the-art technology.

Now, it is a three-year pilot program. Its price tag is $16 million. It helps states to do technology transfer activities. The goal of the bill would be to provide states with a way to tap into the pool of Federal expertise in science and technology.

I do not know if you have had a chance to look at that. But if you have, I would be interested in your opinions. For instance, I gave an example in my opening comments about a small company out in Silicon Valley which has come in and been helped enormously.

Would you comment on this technology extension service concept?

Mr. **Brown**. I have not looked at the legislation that you have in mind.

Senator **Rockefeller**. If I send it to you, would you be willing to comment on it?

Mr. **Brown**. I certainly will. I did not understand it to be the subject of the hearing today, but let me just say that we have two areas beyond the National Bureau of Standards, that do an outreach kind of effort.

One is the National Technical Information Service, the subject of this bill as you know, which does have as its focal point taking technical information developed by the Federal Government in the Commerce Department and other areas, and trying to make that available to the private sector.

I guess that we are careful about using this word now but we are trying to change NTIS into a commercial operation, which will have a good deal more market emphasis to it than the Federal Government seems to be able to give to it.

We have, also, in the work that OPTI does, trying to translate some of the programs that are accomplished at the National Bureau of Standards into use in the private sector. AMRF is an example.

And of course, we have not been without some success in AMRF and our computer integration services in the Bureau of Standards. We do some outreach as it is now, under the way the Department is currently organized.

Senator **Rockefeller**. And I understand and appreciate your defense of what National Bureau of Standards is doing. Mr. Secretary, I would just be interested, when I send this legislation, how you might respond to it.

And I thank you Chair.

The **Chairman**. I thank you, Senator.

Senator McCain.

Senator **McCain**. Thank you, Mr. Chairman.

Mr. Secretary, thank you for being here today.

Mr. Secretary, do we agree that the United States continues to lag further and further behind as far as technology competitiveness is concerned?

Mr. **Brown**. Well, I think the question being raised by this hearing is whether or not we do the job in transferring the technology that we develop in the United States into a——

Senator **McCain**. Marketing and mass production.

Mr. **Brown**. Yes, into a product or a process. Now, the fact is that we are doing a great deal in the area of research and development. We are the leading research country in the world.

And much of that is done by the Federal Government.

Senator **McCain**. I think we are in agreement on that.

Are we in agreement that we are lagging further and further behind in our ability to turn what we have been able to achieve in the area of pure research into an economic advantage and trade advantage throughout the world?

Mr. BROWN. A lot of people have reached that conclusion. I am not sure that I could prove it. But there is some public discussion of that.

Senator McCAIN. Well, then, is that your personal opinion also, that we are lagging further and further behind?

Mr. BROWN. I do not know that we are. If one looks at the patents granted in the United States, we have a continuing increase in the number of patents every year. We run the Patent Office also.

Senator McCAIN. Well, let me ask you, then, what do you view as the proper role of government to play? It was pointed out by Senator Bumpers that we have devoted billions of dollars to research in agriculture areas, in other areas of this country's economic base, but yet, when it comes to technology, we seem to have an extreme reluctance to make any significant investments, particularly in the area of cooperation between business and government.

It appears from your testimony you reject Senator Hollings' legislation, speaking for the administration. What would you view as——

Mr. BROWN. I think what we have rejected in the proposal that Senator Hollings made, if I may say, Senator, because I do not want to leave the wrong impression here, is grant programs because I do not think anyone in the government is smart enough to make those decisions effectively as to who should get grants for what kind of programs. That bothers me.

But in terms of the reorganization, to focus the efforts of the National Bureau of Standards in this regard, I do not think we have rejected it.

Senator McCAIN. Well, there are five major areas of the bill, as I have been informed and in my reading of the bill.

One is increased funding for the National Bureau of Standards.

The other is regional centers for demonstrating manufacturing systems.

Another is reorganization of the Department of Commerce.

Another is grant programs for small businesses and cooperative research ventures.

And the last one is government buy-lease back program.

There are other provisions, but I understand——

Mr. BROWN. Those are three grant programs, one reorganization which we say has considerable merit. And the other one is the funding question, which if you can find the money in the budget outside the Department of Commerce in an appropriate area, we—

Senator McCAIN. Let me pause. I am not sure I understand. Of the five major provisions, you would support how many?

Mr. BROWN. Two.

Senator McCAIN. Which are the grant programs for small businesses?

Mr. BROWN. No.

Senator McCAIN. Which are the two that you——

Mr. BROWN. The three grants we do not support. We can support the reorganization. And if you find additional funds for additional programs, we may in fact in the 1989 budget be asking for additional programs, because we did last year.

But we know that that money has to come from someplace, according to the Gramm-Rudman-Hollings legislation, and we are sure that it cannot come out of the Census Bureau. We are sure it cannot come out of the International Trade Administration. And we do not see anyplace out of the Commerce Department that it can come from.

Senator McCAIN. Well, let me say, Mr. Secretary, I do not think I either understood or you have not been forthcoming in response to the question.

If you only support a relatively insignificant part of this legislation, and you agree that the United States—or it is certainly the body of opinion that the United States is lagging further and further behind in technology competitiveness, I think it is incumbent upon you as a spokesperson for the administration, and anyone else, to come up with some ideas as to how we can improve our position.

I think it is very clear to most of us that we do lag further and further behind. And I would like to see some activity, including perhaps a definition of the role of the government in this very important challenge.

Perhaps you do not agree with Senator Hollings version of what the role of government should be. But I think at least the administration should have an alternative.

Thank you, Mr. Chairman.

Mr. BROWN. The general comment on being further and further behind in technology competitiveness I am afraid I do not understand.

If you mean we do not do sufficient research, then look at the President's competitiveness program.

Senator McCAIN. I thought we just went through that. We were talking about what we develop out of pure research in this country and turning it into a way of making this country economically sound.

And that is, by taking the technology which is developed in the laboratories—numerous examples have been cited here—and converting them into mass production, which then gives us a significant share of the market.

That has not happened in robotics. That has not happened in a wide variety of areas of high technology which the United States invented, and then it was taken by particularly Japanese and other trading competitors of ours.

I think that is pretty clear.

Mr. BROWN. What you cite is certainly true in some areas. I do not think it is true in all areas.

Senator McCAIN. It seems to me, if that is the case, then government and the administration should come up with some proposals, anyway, as to how we can rectify this imbalance.

And perhaps, if the Chairman's proposal is not adequate, you and the administration could come up with some other ideas. That is my point here.

The CHAIRMAN. Senator Danforth.

Senator DANFORTH. If I were a gremlin trying to figure out what I could do to make America less competitive, here is what I would do.

The first thing I would do is to look at our tax laws and try to make a list of everything in the tax laws that had to do with increasing our research capability, and then I would proceed to either cut back on those things or repeal them. I would cut back, reduce the research and development tax credit and sunset it.

I would look at our great universities, the research universities, and I would put caps on how much they could borrow to build their laboratories and buy equipment. I would tax scholarships and fellowships, because we do not want to produce teachers.

I would remove the deductibility for interest for student loans. I would make gifts of appreciated property to our universities taxable.

And then when I went through the list of everything in the tax code that dealt with research and new technology, then I would look at our spending programs, and I think I would start with education. And I would discover how much we are doing for education, and then I would really whack it on the budget. I would cut it by 25, 30 percent.

Then after I did that, I think that I would be on the lookout for any ideas that might crop up in Congress for increasing competitiveness. And I would have a team of Cabinet level or sub-Cabinet level people, very articulate, primed to show up at the relevant committees and bash the ideas.

That is what I would do if I were a gremlin. Are there gremlins loose in the administration?

Mr. BROWN. Not that I am aware of. Are there gremlins loose in the Congress?

One of the things that I would do is have a $200 billion deficit that would give this country a higher cost of capital than any other technological society in the world. And that is one of the problems that we face. The capital here costs a great deal more than it does anyplace else.

Senator DANFORTH. What we do not want to do, of course, is to have a tax code that raises enough to pay for spending. What we do not want is a——

Mr. BROWN. Like you, Mr. Danforth, I did not vote for that tax bill.

Senator DANFORTH. No, no, no. I am the questioner.

And what we do not want is a tax code that promotes investment and savings and education, but rather one that promotes instantaneous gratification and consumption.

On the spending side, of course, we do not want to make any unpopular decisions. We do not want to cut entitlement programs. What we want to do is to cut things like education.

And I know you are not here to carry the brief for everything the government has done. I am not just blaming the administration. I am blaming us. I thought the tax bill was a disaster.

But obviously, that does not have anything to do with what we are here for today. But I really think that we, all of us, the administration, Congress, we have created this wonderful word, competitiveness, or used it. Senator Bradley calls it the "C" word.

We have used this wonderful word competitiveness and put out all our press releases for what we are doing for competitiveness.

But in matters of spending and in matters of taxing, we are doing everything exactly wrong.

And I wonder if—I mean, does anybody in the Administration—maybe there is some Cabinet group or an economic policy council or something that looks at this sort of thing systematically. But does anybody really sit down and say, what are we doing to education, what are we doing to the future of America?

Or are all the decisions made on an ad hoc basis?

Mr. BROWN. They are not all made on an ad hoc basis. The Cabinet councils do discuss precisely the questions you have raised, and it is out of that process that came at least the program that the President submitted to Congress for competitiveness this year.

If I may, I do not know whether I have an opportunity now to respond to everything that you have said up to this point. If there is a question? I will be glad to try to respond to it.

But let me say, as I started to say, that I like you did not vote in favor of the tax bill that was just passed by the Congress. I was not here. You were, and as I understand were opposed to it.

Senator DANFORTH. I made a two hour speech against it and got 22 people agreeing with me. It was not a very good speech.

Mr. BROWN. I have made a lot of those speeches, too, Senator.

The tax bill that was passed, however, in 1981 did stimulate or at least was part of what stimulated the heaviest investment in improvement in plant and equipment that this country has seen except for the period at the end of World War Two, when we were converting from wartime to peacetime.

And in 1983, 1984, and 1985, we had substantial investment in this country, and I think we are still benefiting from it to the extent that we are not utilizing fully all the capacity that we built. It is very difficult for me to answer a question like Senator McCain gave me in general terms, because in some areas we are doing very well and our productivity has improved, and in some areas we are not doing very well and our productivity is suffering.

Some of the technologies are moving and some are not. I sat in on an Economic Policy Council meeting the other day that considered the whole question of superconductivity and how we should address that problem. I am not at liberty to discuss it here, but those items are discussed and the administration does give some consideration to them.

Senator DANFORTH. Good.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Secretary, we appreciate, the committee appreciates you and your associates and your appearance here this afternoon.

We will leave the record open if the other members have some additional questions.

Mr. BROWN. I will be happy to answer any questions that you can give me, Mr. Chairman.

The CHAIRMAN. Very good. Thank you very much.

We have an important panel.

[The statement follows:]

STATEMENT OF HON. CLARANCE J. BROWN, DEPUTY SECRETARY, DEPARTMENT OF COMMERCE

Mr. Chairman and members of the Committee, I am very pleased to be here today to present the Administration's views on S. 907, the "Technology Competitiveness Act of 1987." This bill raises some very important questions about:

One, the ability of American industry to compete as the world becomes increasingly characterized by swift capital flows, new technologies making old industries obsolete, worldwide marketing, fungible labor, and advanced automated manufacturing technology.

Two, the inhibitions which slow American industry's response in translating the discoveries of scientific research into new, commercially viable processes and products.

Three, the extent to which the United States Government itself understands the relative importance of these issues and is capable of doing anything about them.

S. 907 would address these problems several ways:

First, it would give NBS a new mission—that of conducting the necessary generic research for developing new basic technology. This would appear to broaden the Bureau's mission beyond establishing standards, a mission which enables it to make many contributions toward improving quality control, modernizing manufacturing processes, and ensuring product reliability, manufacturability, functionality and cost-effectiveness. As such, NBS would become the National Institute of Technology, while retaining its historic standards setting role for the rationalization of research activity and for quality and technical conformity.

Second, it authorizes additional funds for NBS' important programs in such areas as automated manufacturing research, process control and quality assurance, computerized data bases, fiber optics and related light wave technology, and bioprocess engineering. These, together with other targeted increases, would give NBS some $27.4 million more than the President requested.

Third, it would establish expensive new spending programs. $120 million would be made available over the next three fiscal years to establish regional centers for transferring the manufacturing technology and techniques developed at the Institute to the private sector. Another $50 million would be made available to purchase flexible manufacturing systems and other advanced automated manufacturing equipment which would be leased back to small manufacturing firms. And $40 million more would go toward establishing a fund to help small businesses and joint research ventures commercialize new scientific discoveries.

Fourth, it would reorganize the Department of Commerce with a view toward strengthening its ability to carry out its new, as well as its existing, scientific and technological responsibilities. Specifically, NBS, the Office of Productivity, Technology and Innovation, the National Technical Information Service, and the Japanese Technical Literature Program would be merged into a new Productivity and Technology Administration.

To determine whether this is a sensible approach, we have to answer some fundamental questions: How important is advanced automated manufacturing technology? What are the principal impediments to its widespread adoption, particularly by small business? What is being done to remove these impediments? Are these the kinds of impediments that can be addressed by legislation, public tax dollars, or federal administrative actions?

There is no question but that advanced computer-driven automated manufacturing technology will be essential if American industry is to meet the competitive challenges of the next century. But it would be a mistake to think it is the answer to all our competitive problems or that other technological developments are less deserving of our attention. We have all read the news reports of exciting new developments in superconductivity by the private sector which will affect every aspect of our lives—how we live, travel, spend our spare time *and* how we manufacture the products we use and sell. It will open up possibilities that were dismissed as fanciful only a short time ago. Other new technological breakthroughs may be only an experiment away.

This is not to suggest that flexible manufacturing technology, which is a principal focus of S. 907, is not important. It gives manufacturers increased flexibility in changing product designs and responding to market uncertainties. It can increase machine utilization, reduce work-in-process inventory, reduce the number of machines needed, increase worker productivity, improve quality control and take up less floor space.

Such efficiency benefits are substantial. Controlling by computer the way parts are routed, tools are changed, workpieces are loaded and unloaded, and the way the manufacturing process is inspected and monitored will improve productivity. In the long run, that means more jobs and a better standard of living.

Although many think of advanced manufacturing technology as something that only affects big business, such as the auto industry, S. 907 recognizes its potential for smaller firms. For example, on a worldwide basis, some 75% of all metalworking is done in batch production and most of that is done in batches of fewer than 50 parts. Batch production in small quantities is not economically feasible with conventional automated production facilities because of high retooling and set-up costs. Flexible systems are particularly suited for giving the mid-volume producer of a family of related parts effective control over the manufacturing process.

So, if new processes such as automated manufacturing technology holds this promise, why hasn't adoption been more widespread? There are several problems but the principal ones revolve around cost, justification, time and the absence of standardization. These are not the kinds of problems that can readily be addressed through legislation. However, they *are* being actively addressed.

The problems of cost, justification and time are intertwined. New technologies such as flexible manufacturing or superconductivity may provide lower unit costs, but they are expensive and require high initial outlays, especially if the complete replacement of existing equipment is required. These expenses go beyond mere equipment, however. A firm must also consider the large in-house costs of training workers, reorganizing management, and lengthy installation periods when there is little or no production.

Because it is a major investment with a relatively long payback period, much depends on the confidence of the business community in the health of the economy—a confidence that depends in large part on perception of the Government's willingness to reduce spending. Also, the cost of capital, the exchange rate, interest rates and inflation rates affect both the supply and demand for these technologies. And, as noted, the cost of scrapping existing operable, if inefficient, manufacturing equipment is sometimes difficult for manufacturers to justify.

Most observers tell us that justifying the expense of radical technological changes and determining payback periods using traditional accounting methods is very difficult. Standardized appraisal techniques, such as return on investment or discounted cash flow are useful for conventional equipment, but the benefits of new technologies are much harder to quantify.

This is not a problem that can be solved for industry by NBS or other federal agencies. For this reason, we are very pleased that the National Association of Accountants and the Big Eight Accounting Firms are working to develop, within two years, nationally accepted cost accounting standards for flexible manufacturing systems and other forms of factory automation. This is an important initiative and should do much to hasten the adoption of new manufacturing technologies by firms of all sizes.

Significant strides are also being made to achieve standardization. Many components go into a flexible manufacturing system, including machine tools, material handling systems, robots, computer-aided manufacturing systems software, as well as inspection and other equipment.

How well we get these computers, robots, and machine tools from different manufacturers to communicate and work together in an integrated system is vital if we hope to achieve the fully automated factory. I can't underscore this enough. As *American Machinist* recently put it:

"Smaller companies need to be able to buy automated machines and systems in stages, one or two machines at a time, and build up to an integrated system. They need the flexibility to buy from different vendors at different times with the assurance that the machines they buy will work together properly without expensive, custom-designed interfaces."

It is precisely that on which NBS's Automated Manufacturing Research Facility has concentrated its efforts. Its contribution cannot be overemphasized. As some people out at NBS are wont to say with a great deal of accuracy, the Government is trying to show that it is possible to put together a manufacturing facility the same way you put together a home stereo, from readily available components. It demonstrates clearly that NBS has come a long way from its days as a "weights and measures" agency and has an enormously important role to play in solving the practical problems faced by American industry in trying to modernize and become more competitive.

Although the Government's support for the AMRF activity has been generous, its support comes largely from R&D contracted by other federal agencies or private firms on a reimbursable basis—well beyond its Congressional appropriation. You cannot look just at the numbers in the NBS budget alone to get a true picture of the

Bureau's commitment to a particular project. In 1979, Congress gave NBS $800,000 to get the AMRF started; in 1987 it gave us only $300,000. A reduced commitment by NBS? Of course not. Total AMRF funding grew to $12.5 million because other agencies particularly DOD, were so interested in it that they contracted for $12.2 million in AMRF research.

Private sector involvement has also been substantial. Over the past five years, between $4 million and $5 million of the cost of the AMRF has been borne by the private sector. An additional $1 million has been spent on research associates on the project at the Bureau.

In other words, at a time when so many programs have had to face severe cutbacks, the Bureau's commitment to the AMRF has soared more than fifteen-fold.

What does all this imply for S. 907 from the standpoint of the Government's role in promoting the development and adoption of new technologies?

First, the introduction of advanced automated technology and other technologies into factories will take place but the process in the U.S., Japan, Italy, West Germany or any other major industrial nation will be demand-pull. Unless businesses believe they can justify the costs, and the costs themselves are realistic, the demand just will not be there. Simply stated, you can't push a string.

Second, none of us wants to see the United States left behind but the market for advanced technology will grow more quickly if we make progress in solving some of the problems discussed earlier such as reducing costs through standardization and overcoming the difficulty companies face in justifying the necessary expenditures.

Three, the Government clearly recognizes the importance of advanced technology and, given the need to reduce spending and to meet other important national policy objectives, has tried to use the resources available in the most efficient manner. As we solve the most immediate problems of standardization and justification, we should be in a much better position to decide whether the Government could make additional contributions and, if so, what they might be. One contribution it should not make, however, is to take over the private sector's responsibility for conducting applied research. The Administration believes that the Government should continue to channel its efforts into basic research.

I do not agree that the way to address the question of whether the U.S. successfully commercializes what it invents is by financing a $40 million program to provide small businesses and joint research ventures with seed money to commercialize new scientific discoveries of economic and competitive value.

In effect, S. 907 reflects the view that a lack of capital and a lack of ability to appreciate the commercial applications of developments in basic science prevent us from successfully commercializing what we produce in the laboratory.

The Congress itself considered the question of adequate funding two-and-a-half years ago when its Joint Economic Committee released a survey entitled "Venture Capital and Innovation" prepared for it by Dr. Robert Premus. It concluded:

One, that the investment of venture capital firms is heavily skewed *toward* entrepreneurial companies that are struggling to bring a new technology to market, improve existing technology inherent in existing products or applying technology to the creation of new products and services.

Two, that the best thing the Government could do to ensure an adequate supply of venture capital would be to pursue the kind of sound fiscal and monetary policies that promote a favorable climate for investment, and

Three, that the Government should resist the temptation to interfere with, and distort, the marketplace. In the JEC's own words in Senate Print 98-288: "(G)overnments are often tempted to stimulate economic growth, through direct interventionist methods. . . . Government owned and operated venture capital firms"—which is what S. 907 creates in substance if not in form—"are not condoned in this study."

As to the second perceived "problem," I disagree with those who would suggest that the U.S. is not smart enough to commercialize what it invents. What I do believe is that we have not always been wise about the way we *manage* the technology we develop and that we have given it away carelessly. That is a problem that plagued the private and public sector and, fortunately, both are waking up.

For many years, the private sector, in its effort to expand into new markets, entered into various business alliances with foreign firms, such as joint ventures, licensing agreements, and marketing, manufacturing or supply arrangements under which they gave away precious technology in such fields as consumer electronics. Now we are starting to see these firms becoming a lot more sensitive to the need to demand technology of an equal value in return. This is an encouraging trend and I am confident that the technology flow will no longer be as one-way as it was formerly.

The Federal Government is also moving in this direction. We must keep the lines of international scientific communication open, but we must never forget that those who have the first claim to the benefits of federally funded research must be the taxpayers who financed it. The President has moved swiftly and forcefully to ensure that the technology developed by public funds is transferred to the private sector where it can be commercialized.

For example, for many yeasrs the Government made it hard for a firm to obtain exclusive rights to inventions resulting from federally financed research. Companies saw nonexclusive arrangements as far too risky and Government patents languished on the shelf. Contractors had little incentive to try to develop practical uses for their research discoveries. President Reagan's Executive Order 12591 of April 10, addressed this several ways:

It affirmed the principle that universities, small businesses and, to the extent permitted by law, all other contractors should have the first right of ownership to inventions made with federal funds.

It called for prompt implementation of the Technology Transfer Act of 1986 which provides powerful incentives for federally employed inventors to invent and also authorizes federal labs to consider and select the best proposals for cooperative research from businesses, universities, and state and local governments and sell the exclusive rights to resulting inventions.

It called for greater attention to be paid to the policies and practices of foreign governments before allowing them to participate in these arrangements.

It called for several agencies to establish programs for sharing their technologies with U.S. industries and universities.

It directed agency heads to consider the possibility of establishing basic science and technology centers at universities. These would be in addition to the President's proposal to provide the National Science Foundation with an additional $48 million for Engineering Research Center grants to universities and $25–$35 million for new Science and Technology Centers.

Having stated that much of our problem has been a management one, rather than a lack of creativity, I can hardly disagree with the need to explore new organizational arrangements to improve the way we manage what we invent. The consolidation of OPTI, NBS, NTIS and the Japanese Technical Literature Program under a single roof makes a good deal of sense.

NBS, for example, has agreed to house the Federal Laboratory Consortium which was established under the Technology Transfer Act. It will be in a unique position to support the Administration's efforts to establish policies for identifying private sector needs and transferring federally financed technology to it. OPTI, through its Federal Technology Management Division, Small Business Technology Liaison Division, Industrial Technology Partnerships Division and other offices can provide valuable assistance in this effort. NTIS, of course, has many years of experience in identifying and meeting the needs of the private sector and the scientific community for access to technical information produced by the Government and in licensing federally owned patents.

Housing all of these under one roof makes sense. But, Mr. Chairman, unless we are careful, Commerce will soon have no room for anybody in its parking lot below the rank of Under Secretary. We should not add a new one at this time. We have Under Secretaries for Economic Affairs, Travel and Tourism, International Trade and NOAA and we may be scheduled to get one more for Export Administration in October. The Administration opposes the new Under Secretary. We propose instead that the position of Assistant Secretary for Productivity, Technology and Innovation be dropped and that OPTI be transferred to, and be made a part of, NBS where it will report to the Director who has the status of an Assistant Secretary. The Administration will be pleased to work with the Committee to explore organizational alternatives.

In conclusion, Mr. Chairman, the Administration is committed to helping promote the development of advanced manufacturing technology, but it must do this in an orderly, step-by-step way. It is committed to encouraging the commercialization of basic research and it is doing this by taking firm control of the technology it produces and encouraging the private sector to do the same. If additional funds are to be spent, they should be targeted to those programs where they do the most good, such as the cold neutron facility. That is why the President's Budget includes $6.5 million for this activity.

But whatever direction S. 907 takes, we must avoid repetition of what happened in previous years when cuts had to be made in such critical programs as export and import administration or the Decennial Census in order to fund add-ons. There is no room for tradeoffs in Commerce's budget at this point.

Thank you, Mr. Chairman. I will be pleased to answer any questions.

The **Chairman**. Mr. George Heaton, Mr. William Payne, Mr. Richard Godown, who is accompanied by Dr. Alan Goldhammer.

We are honored this afternoon. We will start with you, Mr. Heaton.

STATEMENTS OF GEORGE HEATON, ATTORNEY, LECTURER, AND VISITING PROFESSOR, INSTITUTE FOR POLICY SCIENCE, SAITAMA UNIVERSITY, SAITAMA, JAPAN; WILLIAM PAYNE, PRESIDENT, UNITED STATES ADVANCED CERAMICS ASSOCIATION; AND RICHARD GODOWN, PRESIDENT, INDUSTRIAL BIOTECHNOLOGY ASSOCIATION, ACCOMPANIED BY DR. ALAN GOLDHAMMER, DIRECTOR OF TECHNICAL AFFAIRS, INDUSTRIAL BIOTECHNOLOGY ASSOCIATION

Mr. **Heaton**. Thank you, Mr. Chairman.

Mr. Chairman, members of the committee. I am George Heaton, a lawyer from Boston, a faculty member at MIT, and for this year a visiting professor in Tokyo, Japan.

The **Chairman**. Let me say, Mr. Heaton, we will include your statement and the other witnesses' in its entirety in the record. You can highlight it or deliver it in full as you wish.

We are not trying to cut you off. We appreciate the luck of having you back in the country to tell us about these kind of things. Maybe we all are wrong and do not know what we are doing.

Mr. **Heaton**. Mr. Chairman, I would be glad to summarize it in the interest of the brevity of the proceedings.

What I would like to do is consider this proposed legislation mostly from an international comparative perspective, particularly with respect to Japan. I make these remarks on the basis of a close professional and personal relationship with Japan and the Japanese people over about the last ten years, and particularly this year during my visiting appointment.

My research there has focused on research consortia. Since in Japan these groups typically receive direct financial support with public funds, this has made my work to some extent an investigation of Japanese technology policy and more generally government-business relationships.

It has been a very pleasant experience to do this research in Japan, in part because the people there are so conscious of the unique American strengths—and point them out to me so often—as well as the apparent fragility of the Japanese situation. It has been amusing this year to listen to people talk about the problems that Japan has. For example, one thing people talk about is en daka, or the overvalued currency, that makes it hard for the Japanese to compete. And then there is kudoo-ka, which is the hollowing out of the Japanese economy and movement of manufacturing overseas. And lastly, the thing that people complain about, particularly the older generation, is shinjinrui, which is a new species of human being—that is the young people of today, who lack work ethic and are only interested in consumption.

The **Chairman**. That is what we have a society of, that last thing. How do I pronounce that, shinjinrui?

Mr. HEATON. Shinjinrui.

The CHAIRMAN. We are full of that.

Mr. HEATON. Well, sitting in Washington perhaps makes it easy to see things the other way around, and it sometimes becomes tempting to emulate policies that seem to have worked in Japan. Although I do believe there is a lot to learn from Japan, I think there are dangers in this approach as well. One big problem is that the policies we know most about in Japan are often obsolete already. This is because the economic and social transformations in Japan have for the last ten years or so proceeded substantially faster than the ability of government policy to keep up.

In considering the Japanese experience and the Technology Competitiveness Act, I think two fundamental concepts should be emphasized, technological innovation and diffusion. Innovation can be seen as the first commercial application of a new product, process, or technical know-how. Diffusion, in contrast, is the subsequent adoption in a different context of that innovation.

In my view, it is diffusion, not technology innovation, that has been the major goal of technology policy in Japan over the last 25 years. Two types of diffusion have been targeted, the importation of technology from abroad and the diffusion of domestic best practice throughout the economy. One of my colleagues in Japan calls this process techno-emulation, and he points out historically all the leading countries, the technologically leading countries, have exploited and adapted innovations from elsewhere, including the U.S. well into this century.

Cooperative industrial research, my focus, has been a mainstay of Japanese industrial policy since 1961, when a special law was enacted to facilitate it. Since then, some 80 engineering research associations have been formed, spread over many different industrial and technical areas. These include industrial alcohol, casting technology, VLSI, and biotechnology, among others.

The most basic conclusion I have reached about these consortia is that, while they are an effective means of diffusing technical information and creating networks among the firms that participate, they have not been where Japanese companies have developed new technologies.

These engineering research associations are distinct legal entities, non-capital and non-profit. The establishment of the enterprise in this manner is necessary to qualify for certain tax benefits, to enjoy special status under the fair trade laws, to receive a government subsidy, and to be supervised by the appropriate ministry. An important institutional aspect is that these associations are almost always "paper" associations. That is, their staff is very small, loaned part time from the members, and they almost never have a central research facility. Rather, each company "takes home" its research funding from the association.

The role of the government is much more that of a facilitator than a director of the effort. In a typical scenario, study groups in both the government and the relevant industry would predate the inauguration of a formal program. Government funding, ultimately extended in much the form of an American RFP, brings a response from the association which, interestingly enough, has been established for the very purpose of performing that requested work.

The funds available to the association, however, are typically earmarked for sufficiently general purposes that the members of the association, not the government, decide who does what. Typically, subgroups work in particular areas, and advisory groups, including technical experts such as university professors, are formed. The government officials involved in these deliberations do not attempt to construct a research agenda for the group, and their role in meetings where technical information is exchanged is essentially that of an observer.

The nature of these engineering research associations has changed. Originally the government intended this program to be mostly for small and medium-sized enterprises, to focus on applied technical areas of immediate generic importance, and to serve more as a catalyst to private R&D than a major source of financial support. By the mid-1970's, however, this initial focus had at least partially given way to a system in which the associations began to serve, and still do to some extent, as a mechanism through which major government research programs were carried out in the private sector.

From the point of view of the individual firms, collaboration of this nature has both virtues and drawbacks. No one in industry with whom I have spoken sees this system as particularly critical to their corporate R&D strategy. The technological leaders in a particular industry tend, for obvious reasons I think, to be lukewarm about participating in an association where other members have more to learn from them than vice versa.

Only when there is a strongly perceived external threat is this kind of collaboration embarked on with alacrity. Nevertheless, it is not difficult to recruit members, since the lure of government subsidy is attractive and there is a strongly felt need to preserve good relationships with the government.

The projects undertaken by the associations seem in fact to have a lower probability of success than those funded internally. Indeed, some association members go so far as to say that negative results are really the best for the association, since they provide some information of value, show companies where not to spend their own funds, and avoid the unpleasantness of having to argue over who might own a success.

In sum, the legal structure of these associations, combined with the competitive dynamics inside the industries, make them institutions unlikely to give birth to much commerciable technology. Rather, they are more appropriately seen as forums for information exchange and networking.

This networking is important, however, and I believe that perhaps today the need for it may actually be increasing as a consequence of new technology's greater complexity and applicability across different industries. Fields like biotechnology or mechatronics, which is Japanese English for the combination of mechanical engineering and electronics, represent a new fusion of previously distinct technical areas and require skill mixes and sources of information that would not have been necessary to innovation in traditional, more distinctly defined industries. Research associations can be the forum for this kind of industry cross-fertilizations.

The research associations also function as a vehicle, at least in Japan, for integrating outside expertise into companies' R&D efforts. To achieve this, university professors or experts from the national labs frequently sit on the consortia's advisory boards and/or the government department responsible for their funding. Finally, the inter-firm linkages developed via the association at the R&D stage often afford the opportunity to achieve standardizations of approach and technical specifications which are critical to the rapid acceptance of some new technologies.

If my hypothesis is correct—that these information exchange and networking benefits, not technology development, are the major virtues of cooperative research—then there is little need for large-scale research budgets. The Japanese government programs seem to apply this principle, since most of the associations have very limited budgets, typically a few million dollars per year.

Any discussion of the Japanese situation would be misleading without emphasizing the important changes now transforming both government policy and private technology development. To characterize these changes in terms I used earlier, one sees a shift from an emphasis on diffusion of technology toward the promotion of innovation.

Among private companies, this trend is evidenced by dramatically rising internal R&D expenditures, bringing the R&D to sales ratio of major Japanese companies to levels as high as or higher than those in the U.S. In the public sector, calls for more basic research and creativity are ubiquitous. To many, this national need to promote innovation carries an essential corollary: the need for changes in the institutional structure to permit more unfettered individual scientific inquiry and entrepreneurship.

Some very recent policy initiatives bespeak these changes. For example, the Science and Technology Agency in the Prime Minister's office recently began funding individual scientists to form teams of their own choosing and work on their own important, but unconventional, subjects. MITI, the Ministry for International Trade and Industry, has also begun to move away from its strong support for engineering research associations.

Last year, for example, MITI and the Ministry of Communications jointly formed the Japan Key Technologies Center using the proceeds from the privatization of NTT, which is the National Telephone Company, and the public tobacco monopoly.

Under this program, which is really a quasi-government venture capital firm, joint ventures organized into profit-seeking firms can receive R&D funding for up to ten years, and this may take the form of equity participation.

While the Japanese government has by no means abandoned its support for joint industrial research, in my view this policy instrument is less important than before and it has been modified. The research budgets have been reoriented toward more basic, longer term scientific inquiry. Membership in the groups now seems more diverse, and the government is retreating even farther from attempts to direct the research agenda.

In some respects, as Japan's policy climate turns more toward basic research and innovation, the challenge for technology policy in the United States presents a mirror image. Having supported basic research and innovation so well, the U.S. should now in my judgment put more emphasis on the diffusion of innovative, but underutilized technology.

The proposed Technology Competitiveness Act is an important step in this direction. In particular, I refer to Title II of the bill, which provides financial support for regional centers to transfer research in manufacturing to U.S. firms.

While I fully concur in the need for this initiative, the details of the program proposed appear too narrowly focused, relying too much on the transfer of technology from government labs to industry. In my view, the first function of these centers should be somewhat different: to diffuse worldwide state-of-the-art manufacturing techniques to U.S. enterprise.

Secondly, I believe it is important for the centers to take their agenda from industry, rather than to attempt to push the adoption of technology already developed in government. A program recently inaugurated in Massachusetts, which is called regional centers of excellence in applied technology, may provide a model in this respect. These centers will be devoted to the diffusion of improved manufacturing techniques, but they will establish their agendas only after extensive interaction with industry groups and individual firms to find out what is needed.

I also support the idea of government funding or at least partial funding for joint research ventures, which is contained in Title IV of the bill. It is unrealistic to think, however, that such associations can contribute very directly to the commercialization of technology, particularly if that technology is of major competitive importance.

I believe, therefore, that the mission of the joint research ventures, which is now characterized in the bill as "creating the generic technology necessary to commercialize new scientific discoveries of great economic and competitive value," should be scaled back a bit to focus on "research of generic importance to the participating firms."

The last portion of the bill I would like to address briefly is the organizational provisions, establishing a National Institute of Technology and a Commerce Department Productivity and Technology Administration. I believe that such a reorganization, even if it involves no new funding, is important—more than merely a reshuffling of government bureaus.

To return to the Japanese case for a moment, it seems to me that one of the biggest factors behind their economic success is that the nation made that a priority. Ever since the restoration of the Meiji Emperor in the mid-nineteenth century, which marked the modernization of Japan, Japan has reached out for, adopted and adapted the technology, know-how and institutions of other countries when these could contribute to its own progress.

It focused its efforts on international competitiveness and showed an extraordinary receptivity to ideas, from whatever source, that could further this goal.

Clearly, the U.S. needs to refocus its energy on making more effective use of technology and improving our international competitiveness, and an institution like the National Institute of Technology with this mandate, which is something we now lack, could I believe accelerate and facilitate the movement that has already begun in this direction.

I thank the committee very much for this opportunity and would be happy to answer any questions or provide any additional information.

The CHAIRMAN. Thank you very much. Mr. Payne, we have your statement. You can highlight it or deliver it as you wish. It is included in its entirety in the record.

Mr. PAYNE. Thank you, Mr. Chairman. My name is Bill Payne. I am an entrepeneur, educated as a ceramic engineer in the Midwest, and have spent my professional career in California.

I am an officer in both the American Ceramic Society and the United States Advanced Ceramics Association, or USACA, as it is commonly known.

The American Ceramic Society, a technical organization, was founded in 1899 and is recognized as the premier organization for the dissemination of technical ceramic information in the world.

USACA is a trade organization of about 30 producers and users of advanced ceramics formed only 18 months ago to identify and eliminate barriers to commercialization of advanced ceramics in the U.S.

Appearing with me, Mr. Chairman, and sitting behind me is Steve Hellem, executive director of USACA. I want to thank you for the opportunity to discuss with you and your Committee important issues relating to advanced ceramics as part of your review of S. 907.

As president of USACA, I want to commend you, Mr. Chairman, as well as Senator Riegle and other co-sponsors of this legislation, for your part in making our country aware of our problems with technology transfer to the marketplace and the key role that new and emerging technologies will play in improving competitiveness in the U.S.

Our membership in USACA, which includes Fortune 500 companies such as General Motors, IBM, and Dupont, as well as entrepeneurships like Ceradyne and Lanxide, have no doubt that numerous applications of advanced ceramics, such as heat engines, electronics, superconductors, aerospace, bio-ceramics, and defense are going to play a large role in U.S. competitiveness in the next 20 years.

And we all know that can be translated into jobs. We are in a worldwide competition for our fair share of new, advanced ceramic markets. In our traditional ceramic businesses, we recognize that technology export has had a dramatic and negative impact on commercialization in this country in the past.

And in advanced ceramics, our basic science is superior, but we have not been able to achieve and hold that edge in the worldwide marketplace. If the U.S. advanced ceramics industry is to become a viable competitor in worldwide markets, we need a focused R&D effort directed at overcoming technical barriers to commercialization of advanced ceramic products.

Mr. Chairman, it is my belief that the key to winning the commercialization race is focused national resources, in the industry, in academia and our consortia, and in government.

The National Cooperative Research Act of 1984 provided a springboard for the formation of R&D consortia. Technology development and quality students have flourished under this act. Both are welcomed by industry. However, neither directly addresses our current concerns.

If we are to succeed, R&D activities must take a bold approach. They must expend sufficient resources in commercialization projects rather than consistently choosing easier consensus projects that develop good and necessary technology and then stop before tackling the difficult commercialization issues.

Technology is a worthy goal. However, technology will not necessarily lead to commercialization unless we make it happen, and right now we are not. These same legislative trends allowing industry to work together in consortia also had a part in encouraging the formation of USACA in 1985.

Our trade organization is focused on identifying and eliminating barriers to commercialization of advanced ceramics in the U.S. We have expended considerable energy on identifying and prioritizing the technical barriers to commercialization and are now outlining for our emerging industry the program necessary to eliminate these barriers.

In short, Mr. Chairman, USACA is prepared to work with government and academia to focus our precious resources on technical programs that will hasten commercialization of advanced ceramics.

But what of our government resources? According to the Department of Energy Estimates, the Federal government is spending approximately $50 million a year in R&D on advanced structural ceramics in several Federal agencies.

We in industry see little evidence of coordination and communications. Among these agencies, in fact, inter-agency competition for support in emerging technologies, such as advanced ceramics and superconductors is notorious.

How can we focus these national resources? The 1985 Research Briefing Panel on Ceramics and Composites by the National Academy complex to OSTP summarized the international competitiveness climate in advanced ceramics as follows, and I quote:

"No single university, government laboratory, or industrial organization has all the elements of what is foreseen as the necessary critical mass of multi-disciplinary personnel to undertake the required programs. (In fact,) the total of all pertinent U.S. organizations in these subjects currently—lack—the dedication and focus of the Japanese efforts in these fields."

We in industry are much better prepared for a coordinated attack of these problems than we were a year ago. Unfortunately, we see no such focus among governmental agencies.

Please do not interpret my comments on lack of focus as suggesting an inability for government to work with industry. Indeed, NBS and the American Ceramic Society have been working together collecting, compiling, critically evaluating and disseminating data on ceramic inorganic phase equilibria since 1933.

In recent years, however, the explosion of indispensable phase equilibria data in advanced ceramics far exceeds NBS resources assigned to this task, and the American Ceramic Society has undertaken an ambitious program to raise $4 million to facilitate creation of a computerized database and to provide funds to sustain the program indefinitely.

Major corporations and governmental agencies worldwide recognize the importance of this program and have contributed to continue this important government-industry program.

Moving now to address some of the specific proposals in S. 907, you should note that our organization has not yet had an opportunity to thoroughly review the contents of your amendments. But I would like to share with you some of my personal thoughts.

Regarding the creation of a National Institute of Technology to serve as a national laboratory, which will provide the measurement and technological services for improved product reliability and manufacturing processes, I would suggest that this is an appropriate purpose for the legislation.

It is important, however, that these efforts not duplicate those of other industry and government activities. If NIT is created, it should provide for coordination of national research and development resources, and insist that efforts at least in advanced ceramics be focused towards commercialization of technology.

Regarding your recommendations in Title II that Cooperative Centers for Transfer of Research and Manufacturing be created, I applaud your concept, but raise for your consideration a potential problem.

If each of these centers is to act as an ombudsman for all new technologies in a region, how can we expect the efforts to be focused and targeted towards commercialization of specific technologies? A possible recommendation would be that these regional centers be created because of unique technical skills in a given area.

Mr. Chairman and Members of the Committee, you can see from my remarks that I personally believe you have identified a very real problem and that you are addressing some of the elements that could make our country more competitive.

My personal opinion is that if we do not create and support a national program to overcome technical barriers to commercialization of advanced ceramics, our worldwide competitors will meet the challenge and in a few years the calls for trade barriers to protect us from worldwide competitors will be loud.

Mr. Chairman, I have appreciated the opportunity to talk with you today. As I mentioned before, USACA is trying to identify the elements of a national R&D program that can help us jump ahead of the competition.

In order to create such a program we need the help of Congress and the administration. We in USACA would welcome the opportunity to work with Members of this Committee to define a program for the commercialization of advanced ceramic products. Thank you.

[The statement follows:]

STATEMENT OF WILLIAM H. PAYNE, PRESIDENT, UNITED STATES ADVANCED CERAMICS ASSOCIATION

Mr. Chairman and Members of the Committee, my name is William H. Payne. I am an entrepreneur, educated as a ceramic engineer in Illinois and have spent my professional career in California. I am an officer in both the American Ceramic Society and the United States Advanced Ceramics Association, USACA. The American Ceramic Society was founded in 1899 and is recognized as the premier organization for the dissemination of technical ceramic information in the world. USACA is a trade organization of about 30 producers and users of advanced ceramics formed only 18 months ago to identify and eliminate barriers to the commercialization of advanced ceramics in the United States of America.

I want to thank you for the opportunity to discuss with you important issues relating to advanced ceramics as part of your review of S. 907 the "Technology Competitiveness Act of 1987."

Mr. Chairman, I want to commend you, Senator Riegle and others in this body who are recognizing the key role that new and emerging technologies continue to play in United States competitiveness.

USACA

USACA is a national trade association representing over 30 companies with an interest in the emerging field of advanced ceramics. The organization is dedicated to promote free market approaches to the advancement and commercialization of advanced ceramics products and in other ways better serve the interests of the United States advanced ceramics industry.

WHAT ARE ADVANCED CERAMICS

"Ceramics" include a wide range of inorganic nonmetallic materials processed or consolidated at high temperatures. You are undoubtedly familiar with the more traditional ceramic products such as dinnerware, tile, electrical porcelain, plumbing fixtures and the like. Technological advances have provided a new, improved class of material known as "advanced ceramics." The potential advantages of these new ceramics are widespread and are extremely important to the future material needs of the U.S.

Advanced ceramics, as functional components in electronic applications, have grown to a billion dollar industry with worldwide competition. Growth of markets for ceramic packages for integrated circuits and multilayer ceramic capacitors, for example, have paralelled growth in use of integrated circuits. Worldwide markets are very competitive with Japan now dominating this opportunity. While these markets are huge, the technology base for production is not mature. New technology offers an opportunity for increased U.S. comptitiveness.

The advantages of advanced ceramics over other materials in structural applications can be summarized as follows:

Improved hardness, wear resistance, chemical durability, optical, and high temperature capability versus metals.

Made from elements abundant in the U.S. and therefore are not dependent upon foreign source raw materials.

Once processing is adequately developed, their costs of manufacture could be low as compared to other comparable materials.

Ceramic components are generally lower in weight than metal equivalents.

Energy saving occurs in many applications, thereby lessening dependence on imported oil.

Ceramics offer improved durability in most applications.

The opportunity for the U.S. to dominate a potentially very large worldwide market in the late 1990s.

Based on the oxides, nitrides and carbides of silicon, aluminum, titanium and zirconium, advanced ceramics have properties which allow them to be used in demanding environments far beyond the capabilities of metals, plastics, or conventional ceramics. The development of high-temperature structural ceramic materials began in the 1960s and was largely motivated by the possibility of substantially improving gas turbines by raising their maximum operating temperatures. The material characteristics offered by the oxide ceramics of that era showed much promise. In the 1970s, several major U.S. Department of Defense research initiatives explored and advanced the experimental fabrication and utilization of ceramics in gas turbines. This work has continued into the 1980s with the U.S. Department of Energy Advanced Gas Turbine Programs. Similar efforts have been undertaken in other countries, notably in West Germany and in Japan. The U.S. Federal Government ceramic R&D work has been instrumental in contributing to the technology base for subsequent work in the U.S.

It has taken many years and considerable resources to achieve to today's process capabilities and variety of ceramic material systems, involving both silicon carbide and silicon nitride, with promise of usable strength up to 1200C or higher.

ADVANCED CERAMIC APPLICATIONS

1. *Today's Commercial Products.* Even though the U.S. advanced structural ceramics industry is small and still highly research oriented, several commerical markets have been developed. These can be summarized as follows:

Electronics—semiconductor packages; multilayer capacitors; pressure and gas sensors; and optical wave guides.

Automotive—electronic controls and catalytic converters.

Defense—ceramic armor; submarine shaft seals; and rocket nozzles.

Chemical Process Industry—mechanical seals; nozzles; and valve components.

Oil Industry—flow control valves; blast sleeves; and bearings.

Metals Processing—high temperature processing; burners; kiln applications; cutting tools; and molten metal filters.

Environmental—waste water treatment.

2. *Today's Prototype Applications.*—Emerging/prototype applications include:

Chemical Process Heat Exchangers
Recuperator for High Temperature Processing Furnaces
Higher Performance Semiconductor Packages
Automotive Valve Train, Combustion Zone and Turbocharger Components

3. *Future Applications.*—The real excitement and future for advance ceramics lie in applications which call for improvements in strength and hardness, as well as thermal, chemical and electrical properties, and are essential because traditional materials are unable to do the required job, e.g., the high temperature ceramics used for superconductors or as the leading edge of the proposed aerospace plane. We see research leading to the use of advanced ceramics in several major industries. These ceramics will be engineered to provide needed properties for the following applications:

Automotive—new engine designs; turbine; low heat rejection (LHR) diesel; and advanced rotary.

Bio-ceramics—artifical teeth, bones, heart valves.

Aerospace—high temperature low weight components for engines; advanced electronics; and fuel cells.

Chemical Processes—advanced composites.

Electronics—advanced multilayer integrated packages and, electro-optic packaging.

Defense—SDI (optical/heat transfer properties); improved armor for high threat levels; defense aerospace applications; and advanced battle tank power trains.

In the case of motor vehicles, the use of ceramic-based engines could significantly affect fuel efficiency and U.S. energy dependence. If the U.S. were to gain a technological and production advantage in ceramic-based engines, domestic automakers would have a competitive advantage in world motor vehicles markets. U.S. automobile imports would be reduced and U.S. exports would increase. Even a relatively small percentage improvement in the U.S. balance of trade in motor vehicles would have a large dollar impact on U.S. motor vehicle production and employment.

A recent study by Argonne National Laboratory cited the macroeconomic effects of U.S. or Japanese dominance on structural ceramic technology for heat engines. Under the U.S. dominance scenario, in the year 2000, U.S. real Gross National Product (1981$) was $34.7 billion greater than the Japanese dominant scenario and employment was higher by 245,000 job.[1]

FEDERAL GOVERNMENT AGENCY FUNDING OF ADVANCED CERAMICS R&D

As discussed above, advanced ceramic materials offer enormous potential to the U.S. in the automotive, bio-ceramics, aerospace, defense, electronic and chemical process industries. However, the timing and need for technological breakthrough is critical. Research on advanced ceramics has in the past been supported by several agencies for the Federal Government, including: Department of Commerce; Department of Defense; DARPA, Army, Navy, Air Force; Department of Energy; Department of Interior; NASA; National Bureau of Standards; and National Science Foundation.

R&D efforts have focused on basic research in the fundamental science of ceramics, development of dependable ceramic process technology, and development of new engineering designs to take advantage of the attributes of ceramics. It is imperative that funding at current or expanded dollar levels be maintained to ensure development of new applications and advanced ceramic materials. This, in turn, will help to ensure a healthy and stable U.S. advanced ceramics industry that will be able to be competitive in a worldwide marketplace.

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[1] Teotia, Arvind P.S. and Johnson, Larry R., "Macroeconomic Effects of U.S. or Japanese Dominance in Structural Ceramic Technology for Heat Engines", *American Ceramic Society Bulletin*, (September, 1985), pp. 1232–36.

A March 1984 Department of Commerce report assessing the competitiveness of the U.S. advanced ceramics industry noted that there are a number of available options to strengthen the competitive position of the United States' engineered ceramics industry. Those suggested options include:

Increasing the amount of Federal Research and Development expenditures related to advanced engineering ceramics.

Increasing the amount of Federal R&D aimed at military and space applications of advanced engineering ceramics and improving the technology transfer function to commercial applications.

Increasing Federal incentives directed toward increasing private industry R&D on advanced engineering ceramics.

Allowing antitrust exemptions for cooperative industrial R&D to develop major advanced engineering ceramic applications and promote the Research and Development Limited Partnership (RDLP) concept for this purpose.

Improving U.S. capacity to obtain and disseminate foreign scientific and technical information (STI).

Increasing educational opportunities and incentives for product design and manufacturing of advanced engineering ceramics.[2]

The report also suggested several options whereby the Federal Govenment could create or improve the market for advanced ceramics:

Increase Federal procurement of advanced engineering ceramics for military, space, and other applications.

Use Federal regulatory policy to increase the market for advanced engineering ceramics.

Provide Federal risk or liability insurance for advanced engineering ceramics producers and/or users in case of catastrophic failure.

Review the Standard Industrial Classification codes to isolate advanced ceramics inputs and products. This would facilitate assessing developments in the industry.

Encourage the various standards setting associations to develop, in concert with the National Bureau of Standards, preliminary reliability standards for advanced ceramics. As more knowledge is available from ongoing research programs, the standards should be revised accordingly.[3]

Mr. Chairman, we are in a worldwide competition for our fair share of new advanced ceramic markets. In our traditional ceramic businesses, we recognize that technology export has had a dramatic and negative impact on commercialization in this country in the past. And in advanced ceramics, our basic science is superior but we haven't been able to achieve and hold that edge in the worldwide marketplace. If the United States advanced ceramics industry is to become a viable competitor in worldwide markets, we need a focused research and development effort directed at overcoming technical barriers to the commercialization of advanced ceramic products.

It is my belief that the key to winning the commercialization race is focused national resources; in industry, in academia and our consortia, and in government.

The National Cooperative Research Act of 1984 (and other related legislation) provided a springboard for the formation of industrial/government/academia R&D consortia. Technology development and quality students have flourished under this act. Both are welcomed by industry; however, neither directly addresses our current concerns. If we are to succeed, research and development activities must take a bold approach, they must expend sufficient resources in commercialization projects rather than consistently choosing easier consensus projects that develop good and necessary technology and then stop before tackling the difficult commercialization issues. Technology is a worthy goal. However, technology will not necessarily lead to commercialization unless we make it happen . . . and right now we aren't.

These same legislative trends allowing industry to work together in consortia also had a part in encouraging the formation of USACA in 1985. Our trade organization is focused on identifying and eliminating barriers to commercialization of advanced ceramics in the U.S. We have expended considerable energy on identifying and prioritizing the technical barriers to commercialization and are now outlining for our emerging industry the programs necessary to eliminate these barriers. In short,

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[2] U.S. Department of Commerce, *A Competitive Assessment of the U.S. Advanced Ceramics Industry*, (March 1984), pp. xvi–xvii.

[3] *Ibid.*, p. xvii.

Mr. Chairman, USACA is prepared to work with government and academia to focus our precious resources on technical programs that will hasten the commercialization of advanced ceramics.

But what of our government resources? According to the Department of Energy estimates, the federal government is spending approximately $50 million/yr. in R&D on advanced structural ceramics in a wide variety of federal agencies. We in industry see little evidence of coordination and communications. Among these agencies, in fact, interagency competition for support in emerging technologies such as advanced ceramics and superconductors, among others, is notorious. How can we focus these federal resources?

The 1985 Research Briefing Panel on Ceramics and Composites by the National Academy complex to OSTP summarized the international competitiveness climate in advanced ceramics as follows, and I quote: "No single university, government laboratory, or industrial organization has all the elements of what is foreseen as the necessary critical mass of multidisciplinary personnel to undertake the required programs. (In fact) the total of all pertinent U.S. organizations (lack) the dedication and focus of the Japanese efforts in these fields."

We in industry are much better prepared for a coordinated attack of these problems than we were a year ago. Unfortunately, we see no such focus among governmental agencies.

Please do not interpret my comments on lack of focus as an inability for government to work with industry. Indeed, NBS and the American Ceramic Society have been working together collecting, compiling, critically evaluating and disseminating data on ceramic inorganic phase equilibria since 1933. In recent years, however, the explosion of indispensable phase equilibria data in advanced ceramics far exceeded NBS resources assigned to this task and the American Ceramic Society has undertaken an ambitious program to raise $4,000,000 to facilitate creation of a computerized data base and to provide funds to sustain the program indefinitely. Major corporations and governmental agencies worldwide recognized the importance of this program and have contributed in order to continue this important government/industry program.

Moving now to address some of the specific proposals in S. 907, you should know that our organization has not yet had an opportunity to thoroughly review the contents of your amendments. But, I would like to share with you some of my personal thoughts.

Regarding the creation of a National Institute of Technology to serve as a national laboratory which will provide the measurement and technological services for improved product reliability and manufacturing processes, I would suggest that this is an appropriate purpose for the legislation. At the same time, it is important that the efforts not be duplicative of other industry and government activities. If NIT is created, it should provide for coordination of national research and development resources and insist that these efforts be focused toward commercialization of technology.

Regarding your recommendations in Title II, that Cooperative Centers for the Transfer of Research and Manufacturing be created, I applaud your concept but raise for your consideration a potential problem. If each of these centers is to act as the ombudsman for all new technologies in a region, how can we expect the efforts to be focused and targeted toward commercialization of specific technologies? A possible recommendation would be that these regional centers be created because of the unique technical skills of a given area.

Mr. Chairman and Members of the Committee, you can see from my remarks that I personally believe that you have identified a very real problem and that you are addressing some of the elements that could make our country more competitive. My personal opinion is that if we do not create and support a national program to overcome technical barriers to commercialization of advanced ceramics, our worldwide competitors will meet the challenge and in a few years the calls for trade barriers to protect us from our worldwide competitors will be loud.

Mr. Chairman, I have appreciated the opportunity to talk with you today. As mentioned before, USACA is trying to identify the elements of a national R&D program that can help us jump ahead of our competition. In order to create such a program we will need the help of Congress and the Administration. We in USACA would welcome the opportunity to work with members of this committee to define such a program and get and keep it focused on its objective, the commercialization of advanced ceramic products.

Thank you.

The CHAIRMAN. Thank you. Mr. Godown.

Mr. Godown. Mr. Chairman, thank you. I will summarize.

I will begin by saying that the U.S. currently has the technological lead in biotechnology in the world, and we do not look forward to a situation where biotechnology is invented in the U.S. and made in Japan. We think that your bill, S. 907, will take us a long way towards preventing that from happening.

Biotechnology is an industry created in the U.S. and this country is the acknowledged world leader in applying the technology in fields as diverse as pharmaceuticals and chemicals, agriculture and medical diagnostics.

Basic research findings of the past 15 years have been translated into commercial products at a rapid pace. Biotechnology companies founded over the past 10 years have an estimated market capitalization of $10 billion and significantly biotechnology research is being conducted at major U.S. pharmaceutical, agricultural, petroleum, chemical and food processing companies.

Products from this technology are presently approved in the animal and health care areas, and it is our expectation that agricultural and food processing products will be commercially available as soon as regulatory compliance issues can be met.

The benefits of biotechnology are great. Pharmaceuticals are presently under development to alleviate the pain and suffering from life threatening medical conditions such as cancer and heart disease. Advances in plant and animal agriculture using biotechnology will lower the farmer's input cost, restoring profitability to this beleaguered sector.

In our testimony today, I would like to address three general areas. The first is an issue that has been affecting U.S. industries since the advent of the worldwide economy international competitiveness.

Secondly, the roles of the Federal government including the National Bureau of Standards in funding and conducting basic and applied generic research will be discussed in the context of industry's role of developing consumer products.

And finally, I will make some remarks concerning S. 907 the Chairman introduced to assist in the transfer of research from our manufacturing industries. I think it is premature to judge international competitiveness of our domestic biotechnology industry.

Too few products are approved for marketing, and those that are approved are in the human and animal health care areas. However, in the area of basic research, as well as industrial research and development, the United States enjoys a clear lead over the countries of Western Europe and Japan.

It is premature the judge international competitiveness of our domestic biotechnology industry. Too few products are approved for marketing and those that are approved are in the human and animal health care areas. However, in the area of basic research as well as industrial research and development, the United States enjoys a clear lead over the countries in Western Europe and Japan.

The reasons for this advantage are easy to understand. Government funding from agencies such as NIH and the National Science Foundation not only resulted in many of the scientific advances that are the underpinning of our industry, but also led to the training of a critical mass of scientists who were able to translate the advances into commercial products.

While industry has increased its commitment to funding research and development, spending over $500 million, it is a principle role of government to provide funds for basic research and scientific manpower training.

The United States biotechnology companies engaged in pharmaceutical research have taken advantage of the leadership provided by developing aggressive licensing programs with foreign companies.

Products have been licensed for royalty payments to companies in Japan and Western Europe. These royalty payments assist the U.S. firms to further their research and development activities that will ultimately lead to new products.

The major industrial emphasis outside the health care sector is agricultural biotechnology. New approaches to plant breeding are being developed, using biotechnology. Environmental and regulatory concerns are spurring development of improved biochemical and microbial pesticides.

This research is taking place at both large and small companies with interests in biotechnology. Again, as with the health care sector, it appears that the U.S. is the world leader in this research area.

One of the chief factors in keeping our domestic biotech industry strong and vigorous is a strong commitment to basic research through Federal funding agencies. This association has testified before Congress in favor of continuation of a strong Federal presence in this area on several occasions in the past.

And as the Chairman knows, the path from basic research to commercial products is not easily predicted. Today's scientific curiosity could be tomorrow's breakthrough.

The additional result of a commitment to the strong research foundation is that there will be sufficient supply of trained scientists and engineers produced by our educational system.

These individuals will go on to careers in industry, seeking to apply their acquired knowledge in developing commercial applications for new industries, such as biotechnology.

Trying to assess what generic applied research will be needed by an emerging industry, such as biotechnology, is at best problematic. Companies will have different perspectives on these needs.

However, one area has been noted as needing further research emphasis, and that is protein engineering. Through the techniques of molecular biology it is possible to redesign proteins and improve their properties in important ways.

This technology has already been used to improve the stability of Interlukin-2, a therapeutic presently under clinical testing as an anti-cancer agent.

Research is presently underway seeking to improve the properties of a number of enzymes that are important in industrial processes. Improved enzyme stability and function is the goal of this line of research, and results are now being realized.

Unfortunately, we do not have all the tools at our disposal to make the maximum use of this technology. It is in this area that the National Bureau of Standards can assist industry in developing the measurement techniques that will be needed to fully implement the benefits of protein engineering.

Better methods must be developed for shortening the time for protein structure, determination and prediction, and the area that the bureau is increasing its expertise in.

We would point out that the Bureau has been assisting the biotechnology industry in the measurements area for some time Illustrative of this help is the research conducted on the enzyme, glucose isomerase. This enzyme is key to the corn sweetener industry. 2.1 billion kilograms of corn sweetener were produced in 1981 for use in a variety of packaged food goods. Bureau scientists have actively worked with industry to measure various thermodynamic parameters of the enzyme so that its function can be better understood. Ultimately this research will lead to an improved production process of lower cost.

I would like to focus the remainder of this testimony on IBA's preliminary observations of S. 907. It is crucial to emerging technologies to have new methods of measurements and standard development.

I point out, protein engineering is one of the areas in biotechnology that could profit from the development of better methods. NBS has in the past operated largely in a reactive mode.

As industries developed, the bureau became involved in standards and measurements development. We are now in the period where industries require measurement and standards during the development process.

This requires support, both in terms of manpower and financial appropriation. It appears as though S. 907 would accomplish this.

We believe that the establishment of a productivity and technology administration, as set forth in Title III of the bill would be useful. It is important that factual rather than anecdotal information regarding foreign competitors be acquired and disseminated as necessary.

At this stage in its early development, the biotechnology industry requires hard data on what efforts are being made in other countries.

Useful information, such as the types of products under development, the nature of government involvement, and what market geographies are anticipated is necessary as our biotechnology industry matures and begins to address world rather than domestic markets.

There has been much talk among industry consortia to conduct research and generic technologies. Some agreements have been reached that have allowed industry groups to either fund or directly conduct the research that will lead to further technological advances.

At a recent meeting of the Keystone Symposium there was a preliminary agreement among some biotechnology companies that such an effort should be considered in the area of protein engineering.

While this initiative is still in its formative stages, it does indicate that there are mechanisms available to companies to jointly participate in such generic research, but on a somewhat limited basis.

The provisions set forth in Title IV of this bill should encourage companies to form joint research and development ventures in generic research areas. The initial funding that can be provided under this proposal may be the impetus that could trigger the formation of more ventures.

In this manner, our industry can overcome some of the bottlenecks that cannot be overcome by individual companies.

Mr. Chairman, we commend the initiative in the introduction of S. 907, and we stand ready to work with you and your staff in the further development of this legislation.

The CHAIRMAN. We very much appreciate it. Mr. Heaton, a quick question and I will yield to my colleagues.

I have been talking without any real knowledge of how you would bring about greater consumerism and less saving in Japan. That is what I hear the Secretary of the Treasury, the President, the administration, and our Special Trade Representatives saying.

We have just got them to consume more. How in the world would they ever do that? You over there in Japan. I mean, is that given any serious thought at all?

I mean, I am sitting over here and if some Japanese minister came over and said, Senator, you have got to start consuming more. If I went down home and started talking that nonsense they would have me committed right away.

I am just wondering how that goes over in Japan from your vantage point as a visiting professor. What is the reaction over there? Is it realistic at all or what are we talking about?

Mr. HEATON. Actually, I think it is quite realistic. There is one policy proposal currently being debated in Japan which I think could increase the funds available for consumption dramatically.

One of the ways the Japanese have encouraged people to save is through the postal savings system. If you open an account at the post office and put a certain amount of money in it, which is now like around $5,000, the income on that is tax-free. It is really quite convenient, because the post office does not really keep track of the taxpayer numbers for those accounts, so that you can really open two, three, four, six, ten and never have anybody keep track of this tax-free money.

The proposal is for the revenue bureau in Japan to keep track of that and to decrease the amount of tax-exempt income that even the reported income that could qualify. If that is so, there is going to be a lot of money around that people will want to spend rather than hide.

The Japanese government is doing that in part because they need money. The Japanese government deficit is enormous, and they need money to finance it. But also I think that is a serious response to the U.S. complaint which is consistent with some other Japanese governmental objectives.

The CHAIRMAN. Well, you are educating me. Is there anything else? That system is very extensive, I take it, from the way you describe it. Everybody is in that game.

Mr. HEATON. Everybody is in that game. It is hard to know to what extent. But it is certainly extensive.

The other thing that may happen is that there may be a great amount of new investment or at least incentives for investment in infrastructure, particularly private infrastructure. By that I mean housing.

As anybody who has gone to Japan knows, housing is poor there compared to America. And there is certainly a lot of room for improvement. If mortgages were easier to come by, for example, there could be a lot more private consumption in that area as well.

The CHAIRMAN. Is that being considered by the government.

Mr. HEATON. Yes.

The CHAIRMAN. Very interesting. Thank you. Senator Exon?

Senator EXON. Mr. Chairman, thank you very much.

I have been very interested in your very expert testimony, gentlemen, and your offer to help us on this matter I think is most encouraging. I think it is an important step in the right direction if we are going to get our technology base and our science turned around, especially given the continuing threat that we have from sources around this world.

I would just like to take this opportunity, although you have not had a chance to study it at all, to mention a proposal that I am considering introducing. We have done some work on possibly creating a technology trust fund, for want of a better name.

Given the budget constraints that we are working under, and I suspect that we are going to have more of that in the future, and recognizing that what I am thinking about is strictly a long-term proposition for the funding and maybe recapturing some funding of the area that you are very much concerned about and we are looking at.

This technology trust fund would simply be, and again I would emphasize it is not going to have a great deal of financial impact in the immediate future, but I am trying to think down the road into the future a little bit, along the lines of perhaps creating a fund under the Secretary of Commerce with a board of that would oversee and supervise the grants for science and technology, student assistance and so forth.

It would focus on computer sciences and engineering, and have an arrangement where the receiving institution, or possibly a private company, would agree or contract to pass some relatively small amount of royalties 2 to 5 percent, back into the fund to be farmed out once again.

A revolving fund if you will, for a long-term government program, basically government managed but leaving the individual research to produce things that can help build factories and create jobs and get things moving for America.

Do you believe that the receiving institutions or individuals, if this were properly handled, might be attracted to give up some of the possible royalties? I recognize that 80 to 90 percent of it probably will never return anything.

But for the 10 or 15 percent that does evolve, and over a period of time, I would think that we could get several millions of dollars to reinvest to continue the wheel in the future. Do you think such a concept has any place in the future, and what do you think of the idea?

Mr. PAYNE. It is not clear to me where the original source, Senator, of these funds is.

Senator **Exon**. It would take an appropriation of some type to get it going.

Mr. **Payne**. Okay. It seems to me that it could even be applied to, let us say, a trade organization, or some organization such as I was mentioning earlier that would allow us to focus national resources.

I am concerned in the advanced ceramics industry that MITI, as an organization, the Fine Ceramic Association of Japan, is orchestrating, for lack of a better word, the growth and expansion of this emerging technology. We have no such overall focus in this country.

It is even conceivable to me that we might set aside some small portion of our revenues toward such a trust, if we could achieve the kind of overall focus that we need that will allow us to focus our emerging industry.

Senator **Exon**. Thank you very much, Mr. Payne. Any of the rest of you have anything to say about this?

Mr. **Godown**. Senator, let me comment on behalf of biotechnology. I also had the same question, where did the original money come from? But you said seed money from an appropriation.

I would have two questions about it. I wonder how much it would produce and whether this 2- to 5-percent royalties would keep the revolving fund revolving. You might need some additional funds going into it.

But in any event, certainly as an initiative, as a means for directing research into an area that is needed, it sounds as though it deserves a very close look.

I would add for the record that industry currently, a number of companies themselves, although we are not doing it as an association, but a number of the companies are already providing major funding at university levels.

There is a cooperative arrangement concerning what happens to the patents and the intellectual information which is developed there from, so that it is very, very much to the advantage of both the university and their scientific and professional staff and to the advantage of the company who is doing, and therefore in general to the advantage of the industry.

We are very hopeful it will produce a number of new discoveries.

Senator **Exon**. I was just thinking along the lines of a source of seed money.

It could be an appropriation. It could be that the board that would be set up as directed by the Secretary of Commerce would not only have the right to make grants under the conditions outlined without specifics.

They also could solicit funds that people might want to put into this. Maybe there would be some tax considerations of some kind. Maybe some new thinking about how we could have a better relationship between those who want to give and those who want to take a chance, and those who would like to produce more research and development.

I have not set any parameters on this at all. I mean it might buy robots in one operation, and it might buy a shredder for corn in some other area. So it is a broad thing.

I have gotten the impression that maybe the grants and some of the things that we have been doing, while most of them have been good, have lacked overall coordination, and there is not the overall purpose that serves the economy of this country.

And I do not mean that this takes the place of anything. I do not mean to say that if a large corporation wants to give a grant to a particular school that it can't, that is fine.

What I am thinking of is a government agency that would hopefully have an overall view of the economy and where we should be going. Maybe it could put some money into something that is not likely to return anything right now, but would 10, 15 years down the road.

Mr. GODOWN. It is certainly an opportunity to get some, what we are calling generic research, research which would be beneficial for everybody in a given area. In my case, my concentration is biotechnology, but this seems like a good way to get it going.

I would add a consideration and an anecdote very, very briefly. Consideration would be that whatever mechanism is set up, it should not have any more bureaucratic glue or molasses than absolutely necessary.

And second, the anecdotal comment is that industry has gotten together in a let-us-talk-about-it stage to see, one, what needs to be done, and then two, how can we go about doing it?

In biotechnology in 45 minutes a number of companies, now albeit these were major companies and so they had the funds at their disposal, got together and decided that there was an area, and this is protein engineering and protein research, which needs to be addressed, and they were able to identify a significant amount of funds which, if the plans come to fruition and if it passes the Department of Justice muster and that sort of thing, will very quickly come into being.

So there is an identified need to do what you are talking about, and we would welcome any mechanism which would facilitate it.

Senator EXON. To answer your question there, my view would be that this would be administered by the National Science Foundation, with existing staff.

We would not be creating any bureaucracy, other than the bureaucracy that would be necessary to form such an organization with the Secretary of Commerce sitting on that group that would make recommendations. But the operation would be handled by the National Science Foundation.

Thank you very much. If there is any other comment I would like to hear it. We would want to work with you people who have had far, far more experience than this senator in this area.

Mr. HEATON. Senator Exon, I would like to point out that there are some mechanisms like what you are proposing, which are working quite well at the state level. I know in Massachusetts, for example, there is a Massachusetts Technology Development Corporation, which performs this kind of function. It is particularly directed toward improvements in manufacturing processes. Within the last year or so Massachusetts has also created a Massachusetts Product Development Corporation, which is an analogous effort but in the area of developing new products. Both of these appear to be working quite well. They fund ventures that are not so easily fundable through the private venture capital markets.

I think that while your idea is a very interesting, worthwhile one, it is important for these kinds of decisions to be made close to the entrepreneurs who are developing the new technology. Therefore an alternative perhaps to consider is to use Federal monies as funding for these state efforts where they do exist.

It is a little bit hard to know exactly which States have such efforts, and that is why I think Senator Bumpers' proposed legislation that surveys of these State-level initiatives could fit nicely with your initiative and would be valuable.

Senator EXON. The only thing I would say about that is that if we started with a grant program to the states and let them handle it, we would be losing centralized control. In order to look far enough into the future, I think that control is necessary.

In other words the Massachusetts program was one that I had heard about and was part of the thinking that helped us come up with this program. But I would think that Massachusetts basically would be doing things and funding things that would probably best benefit Massachusetts and maybe not a corn farmer in Nebraska and vice versa.

Mr. HEATON. No question about that.

Senator EXON. So anyway, did you have anything to add, Dr. Goldhammer?

Dr. GOLDHAMMER. No.

Senator EXON. Thank you very much.

The CHAIRMAN. What type of products are not so easily financed? I am trying to get a better grasp of that in that Massachusetts Product Development Corporation.

Mr. HEATON. Things that appear to be of high risk technically, that maybe have a fairly long development period and will not succeed, and appear to have a low probability of success, causing the entrepreneur to have had difficulty getting money from established venture capital companies.

The CHAIRMAN. Have you got an example or two that you can think of now?

Mr. HEATON. What I could do is submit the report of the Massachusetts Technology Development Corporation for the record by reference. It is full of such examples.

The CHAIRMAN. Very good.

Mr. PAYNE. May I give you an example of a generic type of program that is very close to the marketplace, but very difficult for any single company to undertake?

In the structural ceramic area the concept of using advanced ceramics as a leading edge on an airplane is a little difficult for airplane designers to comprehend. So design rules simply do not exist on how to use structural ceramics in mechanical and structural applications.

We need to get designers and producers of advanced ceramics together. We need to talk about design rules. We need to begin to develop computer modeling for the utilization of advanced ceramics in mechanical and structural applications.

That is the kind of thing that is very close to the marketplace, something that you cannot sell your product to the designer if he does not know how to design it in his system, yet something that is relatively generic and of interest.

The **Chairman**. Very good. Any further comment? The Committee appreciates very much the appearance of each of you here this afternoon. We thank you.

The Committee will be adjourned.

[Whereupon, at 4:20 p.m. the hearing was adjourned.]

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